CANSCORE IN NEWBORN BABIES AND ITS CORRELATION WITH GESTATION AGE

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CERTIFICATE - I

This is to certify that this dissertation entitled **CANSCORE IN NEWBORN BABIES AND ITS CORRELATION WITH GESTATION AGE** is a bonafide record of the work done by **Dr. M. Thirumalai Vasan** under guidance and supervision of **Dr. K.E. Elizabeth** in the Department of Paediatrics during the period of his postgraduate study for **M.D. Paediatrics [Branch-VII]** from 2016-2019.

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CERTIFICATE - II

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DECLARATION

In the following pages is presented a consolidated report of the study ***"*CANSCORE IN NEWBORN BABIES AND ITS CORRELATION WITH GESTATION AGE*"*** on cases studied that I studied and followed up at Sree Mookambika Institute of Medical Sciences, Kulasekharam from 2016-2018. This thesis is submitted to the Dr. M.G.R. Medical University, Chennai in partial fulfilment of the rules and regulations for the award of MD Degree examination in Paediatrics.

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I consider it my distinct privilege and honour to have worked under the guidance and supervision of ***Dr. Elizabeth. K E****, professor and HOD of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekharam. I express my feeling of gratitude for her guidance, constant support and encouragement in making the study possible. Her constant help, patience and guidance helped me during each stage from conception to completion of this dissertation. I am blessed and privileged to be taught by such an eminent teacher.*

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LIST OF ABBREVATIONS

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AC	–	Abdominal circumference
AFI	–	Amniotic fluid index
AGA	–	Appropriate for gestational age
BPD	–	Biparietal diameter
BPP	–	Biophysical profile
BW	–	Birth weight
CANSCORE	–	Clinical assessment of nutritional status score
CC	–	Chest circumference
CCHD	–	Cyanotic congenital heart disease
CHL	–	Crown heel length
CI	–	Confidence interval
cm	–	Centimetre
CNS	–	Central nervous system
DNA	–	Deoxyribonucleic acid
EEG	–	Electroencephalogram
EGA	–	Estimated gestational age
EGF	–	Epidermal growth factor
EPo	–	Erythropoietin
FGF	–	Fibroblast growth factor
FHR	–	Fetal heart rate
FL	–	Femur length
FM	–	Fetal malnutrition
FT	–	Full term
g	–	Grams
HC	–	Head circumference
IGF	–	Insulin like growth factor
IP No.	–	Inpatient number
IQ	–	Intelligent quotient
IUGR	–	Intrauterine growth retardation
kg	–	Kilogram
LBW	–	Low birth weight
LGA	–	Large for gestational age

LMP	–	Last menstrual period
MN	–	Malnourished
MUAC	–	Mid upper arm circumference
n	–	Number
NGF	–	Nerve growth factor
NICU	–	Neonatal intensive care unit
OFC	–	Occipito-frontal circumference
PDGF	–	Platelet derived growth factor
PEM	–	Protein energy malnutrition
PI	–	Ponderal index
Po	–	Post-term
Pr	–	Preterm
p-value	–	Probability value
SD	–	Standard deviation
SGA	–	Small for gestational age
T	–	Term
TGF	–	Transforming growth factor
TSH	–	Thyroid stimulating hormone
USG	–	Ultrasonogarphy
VLBW	–	Very Low birth weight
WHO	–	World Health Organization
WN	–	Well nourished

ABSTRACT

ABSTRACT

TITLE OF THE STUDY: Clinical Assessment of Nutritional Score (Canscore) in New Born Babies and its Correlation with Gestation Age.

BACKGROUND AND OBJECTIVE OF THE STUDY

Low birth weight is a major public health problem in developing countries like India with high morbidity and mortality. There are various methods to determine nutritional status of newborns like weight for gestational age, neonatal BMI, Ponderal index, etc., but each has its own drawbacks. Since neonatal morbidity and mortality is more closely related to nutritional status of newborn at birth, Metcoff developed a bedside tool; Clinical Assessment of Nutritional status score (CAN score) which classifies newborn into well-nourished and malnourished.

OBJECTIVES

Primary Objective of my study was to assess nutritional status of newborn babies using clinical assessment of nutritional score (CANSCORE) within 48 hours after birth and categorize into well-nourished and malnourished and to correlate with gestational age and Secondary objective is to find the association of CANSCORE with other parameters like maternal medical conditions, maternal BMI and neonatal parameters like weight for gestational age, neonatal BMI, PI.

METHODOLOGY

The current study is a hospital based cross-sectional study done on 84 singleton newborn babies delivered Sree Mookambika Institute of Medical Sciences, Kulasekharam with in duration of 18 months. After getting Institutional ethical committee clearance and informed consent form the mother, newborn general information, maternal history and pregnancy weight were noted, following which gestational age was estimated using The New Ballard Score, Anthropometric

measurements and CANSCORE were recorded using standardized technique and the data was enrolled in EXCEL sheet and analyzed using SPSS.

RESULTS

In my study, out off 84 neonates, male to female ratio was 1.15: 1. With the observed mean birth weight was 2380 $\pm$ 205 grams, length 47.67 $\pm$ 2.55 and head circumference was 31.5 $\pm$ 1.31cms. And the incidence of fetal malnutrition was 38.1% according to weight for gestational age, 65.5% by neonatal BMI 60.7% by Ponderal index and 65.5% by CANSCORE. On comparing CANSCORE with other indices, gestational age a moderately positive correlation with CANSCORE (r-0.245) which is statistically significant (p value – 0.024) and CANSCORE has a significant statistically association with weight for gestational age, neonatal BMI and Ponderal index which is also significant relation with maternal early pregnancy BMI.

CONCLUSION

CANSCORE is recommended as a simple, non-expensive bedside tool for assessment for malnutrition among newborn more than 34 weeks of gestation. This is expected to result in early intervention and better outcome.

KEY WORDS:

Fetal malnutrition, CANSCORE, Ponderal index, neonatal BMI, AGA, SGA.

INTRODUCTION

The first 1,000 days of life is unique periods which build a foundation for optimal growth and neurodevelopment across lifespan. The concept of first 1,000 days includes 270 days intrauterine to 730 days postnatal. Thus gestational age and birth weight is good predictor of survival, neonatal growth and overall development.

However, these factors are not a good indicator of acute nutritional status at birth, which is considered to be the key factor for future outcome of the neonates.

The incidence of Low Birth weight (LBW) is persistently high in developing countries like India (30%) than developed countries (5 to 7%).[1] Out of all LBW only 10% accounts for Preterm and remaining are term-Intrauterine growth retarded infants.

The incidence of neonatal morbidity and mortality is very high among IUGR neonates, thus it is important to diagnose early for early intervention. [2]

IUGR neonates are detected by various methods like weight for gestational age, mid arm circumference/ head circumference, Ponderal index, etc. but each method has its own advantage and disadvantage.[3,4]

The most commonly used method in classifying the infants are based on birth weight for gestational age, accordingly infants are classified into three

1. Appropriate for gestational age (AGA),
2. Small for gestational age (SGA),
3. Large for gestational age (LGA).

But theses do not indicate the overall neonatal nutritional status at birth. That is fetal malnutrition are even found in AGA babies and SGA babies need not have fetal malnutrition always.[5] Thus the concept of Fetal malnutrition was developed in 1954 by Clifford and Scott & Usher defined "fetal malnutrition as a clinical state characterized by obvious intrauterine loos or failure to acquire normal amount of subcutaneous fat or muscle". [6]

Various studies have found morbidity and mortality are more in malnourished fetus, whether AGA or SGA and which is even less in well-nourished SGA babies thus Fetal malnutrition(FM), term SGA and IUGR are not synonymous,[5] and one may occurs with or without other.[7,8,9] And it is important to classify babies as with or without fetal malnutrition in additional to birth weight for gestational age(AGA/SGA/LGA).

Small for Gestational age (SGA) refers to birth weight below -2SD for corresponding gestational age.[5,7,10,11] The term Intra uterine growth retardation(IUGR) refers to fetus who failed to reach its own normal growth potential due to adverse effect of various factor. And any infant who is classified as IUGR may or may not have fetal malnutrition.[12]

Commonly used method to distinguishing symmetric and asymmetric IUGR is Roherer's Ponderal index (PI). PI equals to hundred times of birth weight (grams) whole divided by cube of length at birth (cms).[2, 13]

Since the neonatal morbidity and mortality is closely related with the nutritional status of the newborn than the birth weight for gestational age Clinical assessment of nutritional score (CAN SCORE) in newborn was

developed by Reba Michels Hill. CAN SCORE in new born consist of nine superficial clinical sign of malnutrition as described by Metcoff J. and total score - 24 is defined as fetal malnutrition. As CAN SCORE is easy to learn and administrate, so that malnourished infants can be detected early and adequate care can be given.[5]

Pregnancy outcome and fetal nutrition status is influenced by various factors, in which the most important is maternal factors. Though India is fast developing country 2015 Global Hunger Index reported India ranked 20th among leading countries with a serious hunger strike and 3rd among south Asian countries with score of 29.0[14] which is a serious situation and most of population are lives below national poverty which plays a key role in maternal nutritional status and psychological stress.

Low pre-pregnancy maternal anthropometric indices influence the pregnancy weight gain and it is one of good predictor of adverse pregnancy outcome.[15] Other factors includes teenage pregnancy, multiple pregnancy with less spacing, poor education status, maternal medical condition includes anemia, heart disease, pregnancy induced hypertension, gestational diabetes mellitus etc. and infection during pregnancy.

AIMS & OBJECTIVES

The Aims and Objectives of the present study were as follows:

- Primary Objective:
    - To assess nutritional status of newborn babies using clinical assessment of nutritional score (CANSCORE) within 48 hours after birth and categorize into well-nourished and malnourished and to correlate with gestational age.
- Secondary Objective:
    - To find the association of CANSCORE with other parameters like maternal medical conditions, maternal BMI and neonatal parameters like weight for gestational age, neonatal BMI, PI.

HYPOTHESIS & JUSTIFICATION

Scientific Justification:

Fetal malnutrition is the major public health problem with high neonatal morbidity and mortality rate, which may be missed by assessing birth weight. So assessment of nutrition status by CANSCORE, which is an easy tool for identification of malnutrition, can help in appropriate interpretation and better outcome.

Hypothesis:

Null Hypothesis: There is no difference in CANSCORE among newborn babies with and without malnutrition.

Alternate Hypothesis: There is a significant difference in CANSCORE among newborn babies with malnutrition I comparison to those without malnutrition.

REVIEW OF LITERATURE

Clifford (1954) was the first one to describe a group of infants with striking physical similarities that suggest a growth disturbance. These babies were long and thin with alert expressions: decreased subcutaneous, subareolar and thigh fat, prominent ribs and long nails. These dysmature infants were growth deprived near the end of pregnancy so that their weight but not length was reduced.[6]

Pick (1954) recognized malnutrition in three newborn babies and all of these babies were term, with birth weight < 2.2 kg and length of 48.3 to 53.3 cm. All three babies had placental abnormalities- placental insufficiency with marked thickening of the umbilical arteries and marked narrowing of lumens. Postnatally, these three babies had rapid growth on high caloric feedings. Thus malnutrition began late in the 3rd trimester and that was probably related to inadequate nutrition delivered to fetus from an abnormal placenta. In Fetal malnutrition, the underlying muscle and subcutaneous tissue are diminished thus resulting in loose skin of arms, inter scapular regions, knees, elbows & legs thus in severe fetal malnutrition, newborn looks "emaciated or marasmic". [16]

Wigglesworth et al. (1966) noted malnourished neonates may suffer from hypoglycemia, hypothermia due poor thermoregulation due deficit of adequate brown adipose tissue during neonatal period even massive pulmonary haemorrhage unduly liable to die.[17]

Battalgia and Lubchenco (1967) charted standards for anthropometric variables like birth-weight, birth- length and head circumference of newborn for at different gestational ages, that helped in classification of infants as "appropriate for gestational age (AGA), small for gestational (SGA) age and large for

gestational age". Dubowitz, as mentioned by above studies, has contributed the classification of growth retardation in according to gestational age for the better understanding.[18]

Thus Naismith's hypothesis (1969) has disagreed that the fetus is not a parasite, which extracts only 2%-4% of nutrients reaching fetus from placenta; and 96%-98% were returned back to maternal circulation via placenta. It is the fetus is either underfed / overnourished, which is highly dependent on rate of extraction.[19]

Duncan et al. (1970) suggested in his publication that pituitary hormones - growth hormone & androgen play a bit important role in intra uterine fetal growth. Whereas the insulin & thyroid-hormone has a major effects on fetal growth, fetal malnutrition is related to hormone deficiency which is rare.[20]

Myronwinick et al. (1970) published review- article on animal studies on rats which showed malnutrition will be curtail at the rate of cell division, if it occurs at the period of hyperplasia resulting in permanent deficiency of cell number in brain. [21]

George Cassady (1970) published a review article, summarizes anatomical similarities between intrauterine and extrauterine malnutrition. Effect of malnutrition differs from each organ was apparent, with selective sparing of skeletal, nervous system and Impairment of thymus growth which are related with degree of malnutrition and weight loss. And similar disproportion is seen in the intrauterine growth retarded infants, whose birth length and size of brain are spared. In relation to body weight, thymus and liver growth are very seriously affected.[22]

Fitzhardinge et al. (1972) did a study on 96malnourished infants to find the incidence of neurological sequelae. The Major neurological sequelae was not that common, with incidence of cerebral palsy and convulsions were 1%and 6% respectively. The cerebral dysfunction was characterized by hyperactivity and short attention span also learning difficulties with incidence of 25%. 69% were noted to have EEG abnormalities and average IQ was 95 & 101 for boys and girls respectively.[23]

Urasti J et al (1972) did a study on 128 infants, in which 36 infants were SGA with signs of fetal malnutrition and 12 death, 3 among them had intrauterine fetal malnutrition.[24]

Morey et al. (1974) conducted a study on newborn of which 11 malnourished and 5 normal infants were included. In these newborn, plasma glucose, amino-acid, ketone bodies, lactate, pyruvate, glycerol, serum cortisol level, serum growth hormone with insulin levels were measured within first 24 hours of life. By 2nd hour of life malnourished infants noted having significant low plasma glucose level than that of normal nourished infants.[25]

Robert H Usher et al. (1974) in his definition, "it should be apparent that not all infants affected by fetal malnutrition will be included in a definition based on low birth weight for gestational age certain infants are genetically predetermined to be excessively large and may manifest fetal malnutrition by soft tissue wasting and chronic fetal asphyxia even though they do not fall below the normal range of weight for date." Conversely, other newborn will be smaller than usual, for their gestational age due to its genetic predisposition, rather than any other pathological reasons, like soft tissue wasting and has no risk of mortality associated with their smaller size.[10]

Robin Fancourt et al. (1976) in his study noted malnourished infants are more likely to die at birth than the normal infants. The Follow-up study showed, that some of these infants continues to have poor growth. They may have a higher incidence of intellectual disability with significant number with poor school performance.[26]

Barker DJP et al. (1993) did a large retrospective study in low birth weight infants. Where he observed there was a high incidence of cardiovascular disease including hypertension, increased plasma fibrinogen & factor VII concentration, with increased plasma glucose levels.[27]

Hill RM et al. (1984) did a study on newborn and found malnourished infants have high incidence of perinatal problems with increased risk of CNS sequelae irrespective of AGA/ SGA. Fetal malnutrition is highly missed when classifying them using birth weight for gestation age i.e 45% of AGA infants were noted to have fetal malnutrition. on follow up all malnourished infants 39% had neurological squeal like intellectual disability, learning disorder, neurological deficit with seizures in late infancy and early childhood.8 In another study by Hill et al. (1984) on 33 malnourished infants, they noted nearly half of the infants had normal birth weights, length and head circumference i.e more than 10^{th} percentile corresponding to gestational age. On follow up of theses malnourished infants for 12-14 years revealed that malnourished infants have significant long-term neurological sequlae like low Intellectual quotient.[8]

Henrichsen L et al. (1986) did a study on 14 pairs of monozygous-twins who had different pattern of intrauterine growth. On long term follow of these infants showed significant difference in their CNS outcome like reduced IQ. [29]

Meadows NJ et al. (1986) did a study to know the prevalence of Intrauterine Growth Retardation, by MAC/HC (occipitofrontal) and noted this is the more accurate method in identifying IUGR than weight for gestational age. Thus the MUAC/HC provides a more accurate and cheapest way of assessing IUGR.[30]

Patterson RM et al. (1987) conducted a prospective study on 355 singleton newborn of gestation age above 35. Anthropometric variables like Birth weight, birth length, head circumference were measured, ponderal index and MUAC/HC were calculated. The result concluded ponderal index & MUAC/HC ratio was more appropriate than birth weight for gestational age.[31]

Georgieff MK et al. (1989) did a prospective study on infants to know the usefulness of MUAC and MAC/HC indices in assessing longitudinal growth of hospitalised preterm-infants and the study concluded that MUAC and MUAC/HC are very much useful for assessing the longitudinal growth of preterm infants.[33]

Sharma JN et al. (1990) did a study one 1000 singleton newborn of gestational age between 28 and 44 weeks. Anthropometric measurements were done within 48 hours. Using Regression analysis standard curves were drawn for MAC & MAC/HC against EGA. And these standard curves were made available as a discriminate method for non-invasive screening of IUGR in growing preterm population.[34]

Golebiowska M et al. (1992) did a study on 1110 neonates, of gestational age 30 to 42 weeks. Anthropometric variables like birth weight, length, MUAC and HC were measured. Individual MUAC/HC was calculated and plotted against gestational

age and the results concluded that MUAC/HC was a very good tool in assess the nutritional status of newborn and to label the newborn as 'the group of risk'.[35]

Cintra L et al (1993) did a review and summarized the way how prenatal malnutrition affects the development of brain. He has observed that malnutrition not only affects the brain growth during the brain growth-spur also during early neurogenesis, cell differentiation and migration. Thus the malnutrition results in different Patten of neurological dysfunction including learning disabilities.[36]

Baker DJP et al. (1993) proposed that under-nutrition during intra uterine gestation, reprogram's the relation between glucose & insulin and same way between growth hormone & IGF. This Reprogramming of relation may be analogous to the programming of the TSH & thyroid axis in congenital hypothyroidism, were the TSH / thyroxine ratio remains very high. Thus the Insulin resistance or deficiency are highly associated with disease of CVS during adult life, same way growth hormone deficiency has an increased risk for cardiovascular disease with high mortality.[27]

Richter et al. (1993) conducted a study on 53 infants and found 23 infants were malnourished (group-1), 15 with liver disease (group-2), and remaining 15 without liver disease (group-3). Routine blood investigation was done on these infants in additional hepatic detoxification capacities was measured using non-invasive method like "urine non-radioactive 15-N methacetin test". In groul-1, malnourished infants was noted to have low urine non-radioactive 15-N methacetin levels like group-2 infants but the serum parameters are within normal levels. So this concludes the effect of intra uterine malnutrition has an effect on liver function in early neonatal period.[37]

Metcoff (1994), conducted a large study, were the study devised the present CANSCORE for the assessment of Fetal malnutrition, and reported only 54% of SGA & 5% of AGA fetal malnourition. With total incidence of FM term neonates was 10.9%. This concludes that all SGA babies are not malnourished.5 Similar study conducted by J Metcoff (1994) were they classified infants into two groups based on growth chart into AGA & SGA and noted not all SGA babies had fetal malnutrition same way not all AGA babies are well nourished.[5]

Kebede et al. (1994) did a cohort study to know the health consequences in malnourished infants who had a long term follow up for 13 years, and the concluded that morbidity and medical illness are high among the malnourished infants with poor catch up growth.[38]

Blatt GS et al. (1994) conducted an experimental animal study on rats, and found prenatal malnutrition has an effect on hippocampal formation with local 5HT system; serotonergic system and also on ligand binding & neuro-chemical study.[39]

Barker DJP (1995) conducted a study on coronary heart disease in fetus and stated fetal malnutrition during middle and late gestation leading to disproportionate growth failure, followed by fetal-coronary heart disease.[40]

Gorman et al. (1997) conducted a study on fetal malnutrition and concluded fetal malnutrition has a significant effect on cognitive outcome on infants during early childhood.[41]

Mehta S et al. (1998) conducted a study on CANSCORE at birth and showed CANSCORE is simple bedside clinical index for detecting FM and it is

noted be a good predictor for morbidity and mortality associated with fetal malnutrition without any specialized equipments.[42]

Rao MR et al. (1999) conducted a study on 372 newborns, to find the suitability of CANSCORE for early assessment of fetal malnutrition. This study suggested CANSCORE is more feasibility and accurate method to detect fetal malnutrition when the total score was modified to 22 as cutoff (excluding hair a one of the parameter). Thus Modified – CANSCORE by Rao, is simple, rapidly performed and easily quantifiable method for assessment of fetal malnutrition in full-term neonates.[43]

Deodhar J et al. (1999) in his (observational) study discussed, prevalence of FM in term neonates by CANSCORE and risk factors associated with FM were he Concluded CANSCORE is a simple, rapidly performed clinical scoring system for detecting fetal malnutrition in term neonates.[44]

Giiner K et al. (2002) in his study showed CANSCORE is an simple, easy and more effective way to identify fetal malnutrition in neonates and total scores can be obtained readily using established steps in assessing malnutrition.[45]

Divya Tailor et al. (2002) did a cross-sectional study and concluded CANSCORE can be used as a simple-clinical index in identifying fetal malnutrition at birth has a high predictive index in neonatal morbidity.[46]

Owen P et al. (2003) in his showed, customized fetal- weight estimated percentiles in late 3rd trimester are much useful in the identifying infants with IUGR but they are less accurate than calculated growth velocity in prediction of infant with low PI.[47]

Kushwaha KP et al. (2004) conducted a study on term neonates to look for CANSCORE and its relation to neonatal outcome, and the study concluded fetal malnutrition is evident in AGA babies, with not all SGA truly malnourished by CANSCORE. Neonatal morbidity and mortality are noted more with fetal malnutrition irrespective of SGA or AGA.[48]

Liladhar K et al. (2006) in his study detected more number of fetal malnutrition by CANSCORE which is not identified by any other method. Thus the study concluded CANSCORE is the simple bedside clinical index for identifying FM at birth.[49]

Adebami OJ (2007) conducted a study in finding effect of maternal nutritional status and SES in the etiology of fetal malnutrition. And it was noted to gross improvement in nutritional status and SES of mother is likely to decrease the incidence of fetal malnutrition at birth.[50]

Agal P et al. (2008) conducted a study to determine the effectiveness of CANSCORE in detecting FM. And the result concluded CANSCORE is simple bedside-clinical index in identifying FM which is the good indicator of FM and with more sensitivity on comparing with other methods like birth weight for gestational age and PI.[51]

Leonard H et al. (2008) conducted a study to find the correlation between intra-uterine growth with intellectual disability and the results were suggested intellectual disability is more prevalent in intra-uterine growth failure infants than the normal infants.[52]

Adebami OJ et al. (2008) conducted a comparative study between CANSCORE and anthropometric indices for detection of fetal malnutrition and the result concluded CANSCORE is more useful and easy tool in detection of fetal malnutrition for routine screening at birth.[53]

Gangar J et al. (2009) did a study on infants born to HIV positive mother and nutritional status of these newborn was assessed using CANSCORE and the results concluded CANSCORE is good screening tool for nutritional status at birth.[54]

Naveen Sankhyan et al. (2009)Conducted a prospective study on 529 term healthy babies were he concluded CAN score can identify fetal malnutrition which can be missed by other methods and helps in identification of well-nourished infants which is classified as growth retarded by other methods.[55]

Popi sifianou (2010), conducted a cohort study on 418 Term & near-term neonates for the diagnostic approach of growth restricted neonates and concluded clinical assessment and anthropometric indicators in combination can define growth restriction better than any other tool. [56]

Ayse Korknaz et al (2011) did a study to find fetal malnutrition and its impact in preterm infants were his study concluded fetal malnutrition can be easily detected by CANSCORE and early and appropriate detection of malnutrition in neonate has a very important role in neonatal morbidity and mortality which is achieved by CANSCORE. [57]

Mahalingam Soundraya et al.(2012) done a prospective study comparing CANSCORE & other anthropemetric indices were the study concluded fetal malnutrition is best identified by CANSCORE.[58]

Vikaram Singhal et al (2012) conducted a study for period of 2 months on 200 singleton full-term neonates and study concluded CANSCORE can identify fetal malnutrition in the neonatal, even when they are by any other methods in detecting fetal malnutrition.[59]

B. N. Ezenwa et al (2013) did a study on preterm to determine fetal malnutrition, study concluded fetal malnutrition can be identified more easily by CANSCORE than anyother methods like PI, MAC/HC and birth weight. Fetal malnutrition is more prevalent in preterm babies irrespective of method adopted for assessment of malnutrition.[60]

Girish Nanoti et al (2013) conducted a study on 60 neonates and found 11.6% Clinical Assessment of Foetal Malnutrition Using 'CAN Score' in Full Term malnourished by CANSCORE. On comparing all methods in assessing malnutrition CANSCORE is simple- clinical index which is more easy and accurate.[61]

Abhay Kumar Dhanorkar et al (2014) conducted a study to detect fetal malnutrition in 384 neonates in which 67.7% babies were well nourished remaining 32.35 was malnourished by CANSCORE and 24.48% by PI. So CANSCORE picks ups malnutrition more than other method and it is a simple-clinical method for screening malnutrition in neonates.[62]

AS Ali et al (2016) reviewed an article on method for assessing nutritional status in newborn, in which he concluded growth chart, PI, CANSCORE are the commonly used diagnostic tools for detecting fetal malnutrition. And CANSCORE is the good screening tool for detecting fetal malnutrition but it needs adjustment for preterm infants for detection of fetal malnutrition.[63]

Abhay Kumar Dhanorkar et al. (2014) did a study to compare CANSCORE and other method in determining malnutrition and his study concluded malnutrition is a predictor of fetal morbidity and mortality which can be identified more easily by simple clinical index - CANSCORE.[64]

Faheem M et al. (2014) did a prospective study in 400 term healthy newborn with cutoff of 25 were he identified maximum malnutrition newborns and thus his study concluded CANSCORE is a simple-clinical index for detecting fetal malnutrition which is even missed by other tools in identifying malnutrition.[65]

Almarzoki Jasim M et al. (2015) did a cross section study on term neonate, inwhich around 1/3rd neonates were detected malnourished by CANSCORE. On combing CANSCORE with BMI which is sensitive index of malnutrition yield of report is high.[66]

AjayMohan Varahala et al (2015) undertaken a study on 125 newborn of term gestation, in which the study concluded CANSCORE is a simple and more accurate bed-side assessment requiring no equipments and easily trainable, so can be used in primary care level to prevent long term morbidity in malnutrition.[67]

Ezenwa BN et al. (2016) did a comparison between CANSCORE and other Indices. Study found BMI was the most sensitive index for detecting fetal malnutrition and on combining with CANSCORE it was stated as a good tool for identifying fetal malnutrition.[68]

Ajai sethi et al. (2016) did a study, in which 23.2% were labelled malnourished by weight for gestational age, 24% by PI, but CANSCORE detected 41% of total newborn as malnourished hence the study concluded CANSCORE as a simple and easily trainable clinical index to identify fetal malnutrition.[69]

Ezewan BN et al (2017) carried a study on preterm newborn were PI was noted to have better sensitivity over others including CANSCORE.[70]

Amarendra M et al. (2017) carried out a study on 250 neonates in which detected 68.4% as malnourished by CANSCORE, 61.6% and 56% by Ponderal index and Kanawati index respectively. Thus he concluded CANSCORE as a simple and systemic method of identifying malnutrition requiring no sophisticated instruments or any major calculation.[71]

Ajay Mohan Varahala et al. (2018) conducted a study on 125 neonates in a tertiary care centre in which 63.34% of babies born to primi mother and 73.33% babies born to mother of low haemoglobin was noted to have fetal malnutrition. Thus study concluded maternal factors plays a major role in the size of newborn at birth and the fetal malnutrition is highly influenced by parity, maternal haemoglobin status and mode of delivery.[72]

Surinder Singh et al. (2018) did a prospective observational study on 529 newborn babies in which fetal malnutrition by CANSCORE was seen in both in AGA and SGA babies and study concludes CANSCORE is a simple bedside clinical index for identifying malnutrition in newborns without any sophisticated equipments.[73]

INCIDENCE

In India Incidence of fetal malnutrition is not clearly defined, however based on WHO criteria incidence of LBW in India is around 30-40% with 7-10 million infants born LBW annually thus these LBW babies are even found in term infants which is suggestive of IUGR.2 In developing countries like India nearly 80% of all neonatal mortality are found in LBW and IUGR.[2]

LBW is major determinant of nutrition station of growing infants i.e. 40% of LBW infants are noted malnourished at 1 year of postnatal age and has ~3times increased risk of mortality on comparing with normal neonates.[2]

Metcott J (1994) noted 10.9% term-newborn with fetal malnutrition by CANSCORE which includes 5.5% of AGA and 54% of SGA babies.[5]

Mehta et al. (1998) classified newborn based on CANSCORE with 25 as cutoff and noted 40% with fetal malnutrition and 60% normal nutritional status were PI detected only 25 % as malnutrition.[42]

Rao R et al. (1999) from his study showed 12% had fetal malnutrition among AGA population with overall prevalence of 51%.[43]

FETAL GROWTH AND DEVELOPMENT

Life begins when monocellular zygote is formed by fertilization of ovum by sperm. Thus the most dramatic events happens in-utero resulting in development of fetus.[74]

Fig. 1: Milestones of human embryogenesis[75,76]

Five major stages of human embryogenesis.[75,77]

Table 1: Stages of Embryogenesis

Stages	Name	Event
1	FERTILIZATION	Fertilization of ovum by sperm to zygote.
2	CLEAVAGE	Initiation of cell division
3	IMPLANTATION	Invasion of embryo into endometrium
4	GASTRULATION	Migration of cells that forms the body parts
5	ORGANOGENESIS	Relative growth of organ and body parts

Domains of fetal growth and development [78,79]

1. Somatic development
2. Neurological development
3. Behavioral development

1. SOMATIC DEVELOPMENT

A. Embryonic period

It is the period from the time of conception till the completion of 8 weeks. By 1st week implantation begins and the embryo consists a blastocyst (i.e a spherical mass with central cavity). By 2nd week implantation completes with established utero-placental circulation. Here it has 2 distinct layer – ectoderm & mesoderm which is followed by formation of amnion. By 3rd week mesoderm appears with primitive neural tube and blood vessels formed with paired heart tubes. By 4 week to 8 weeks all the layers develops respectively thus by end of embryonic period embryo weights ~9g with 5cm length having developed rudiments of all system.

B. Fetal Period

By starting of 9 weeks, structural remodeling of organs happens with increase in cell counts. By end of 12th week gender is more clearly appreciable with initiation of development of lung happens. By ~20 to 24 weeks in lung primitive alveoli is formed and production of lung surfactant begins. During 3rd trimester body begins to store fat and proteins with other nutrient thus 3000g gram baby born with ~50 cm length.

2. NEUROLOGIC DEVELOPMENT

By 3rd week, on the surface of ectoderm neural plate appears. By infolding, CNS and PNS are developed from neural tube and neural crest respectively. By 5th week CNS are divided into 3 divisions like "forebrain, midbrain and hindbrain". Were as in PNS dorsal and ventral horns are formed. By mid-gestation, myelination begins and they continue throughout till 2 years of postnatal age.

3. BEHAVIOURAL DEVELOPMENT

By 8 weeks, Muscle contraction is first noted followed by lateral-flexion movements. By 14 weeks breathing movements and swallowing movements develops. By starting of 17 weeks grasp reflex appears and completes by 27 weeks. By 26 weeks eye opening appears.

CLASSIFICATION OF INFANTS BASED ON GESTATIONAL AGE

Infants are classified broadly into three groups based on gestational age (WHO, 1950) which is independent of birth weight.

Table 2: Classification of Newborn according to Gestational Age

1.	Pre-term	Less than 37 weeks
2.	Term	37 weeks to 41 weeks 6days
3.	Post-term	42 weeks or more

Gestational age is estimated by various methods like calculating with LMP, ultrasonic estimation, New Ballard score etc.

In routine practice, detailed history and physical examination gestation age can be calculated using first day of last menstrual period. However maternal reacall is more subjective and may have lots of error so objective assessment method is mandatory for gestational age calculation.[80]

Ultrasonic guided estimation of gestation age is considered as gold standard method in early 2nd trimester. It is done by measuring BPD (biparietal diameter) which decreases as gestational age increases and measuring the calcified length of fetal femur.[81]

Now in pediatrics The New Ballard Score is used as the standard method in assessing gestation age at birth. It has 2 major component like neuromuscular maturity and physical maturity.[82]

ANTHRAPOMETRIC MEASUREMENTS

BIRTH WEIGHT

It is the most commonly used anthropometric indices and marker to identify nutritional status of the newborn. Birth weight is the determinant of morbidity and mortality in neonates. But when taken alone it has very less significance so needed to be compared with other parameters like gestational age, birth length, etc. sometimes it may give us false interpretation at the cost of excess fluid.[83]

Weight of the newborn is measured using an electronic weighing machine which has minimum units of 10grams. Baby should be nude or with minimal light dress. Before recording weight, zero correction should be made. Following that baby should be placed comfortably in the middle of the measuring pan. Serial measurements should be made to avoid errors.

Fig. 2: Weighing machine

It is universally accepted growth chart. WHO conducted a multicentre growth reference study in 6 different countries with different level of economic status to prepare a standard growth chart, and the countries include India, Brazil, Ghana, Norway, Oman, USA.[84]

CLASSIFICATION OF INFANTS BY BIRTH WEIGHT FOR GESTATIONAL AGE.[18]

Based on the birth weight in relation to gestation age newborns are classified into three groups as mentioned below.

Table 3: Classification of newborn according to weight for Gestational Age.

SGA	Small for gestation age	< 10^{th} percentile	< -2 SD
AGA	Appropriate for gestational age	10^{th} – 90^{th} percentile	-2 to +2 SD
LGA	Large for gestational age	>90^{th} percentile	> +2 SD

Accordingly newborns are classified into 9 subgroups based on gestational age classification and birth-weight for gestational age.

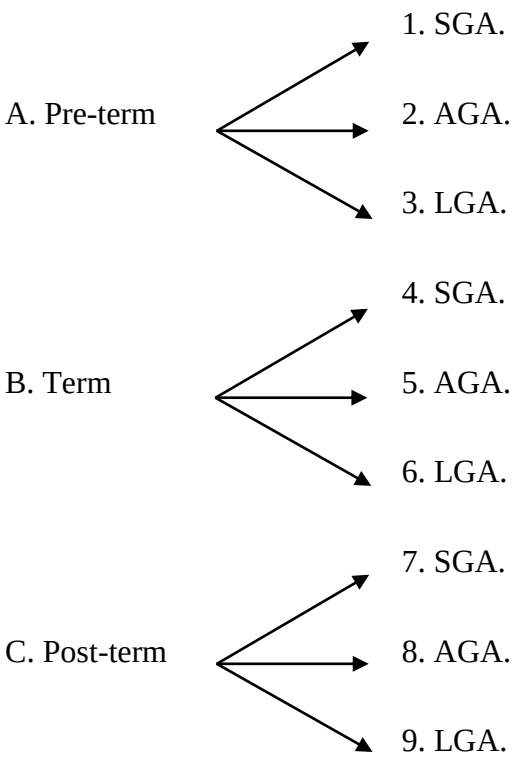

Fig. 3: Classification According To Gestational Age & Birth Weight

It is universally accepted growth chart. WHO conducted a multicentre growth reference study in 6 different countries with different level of economic status to prepare a standard growth chart, and the countries include India, Brazil, Ghana, Norway, Oman, USA.[84]

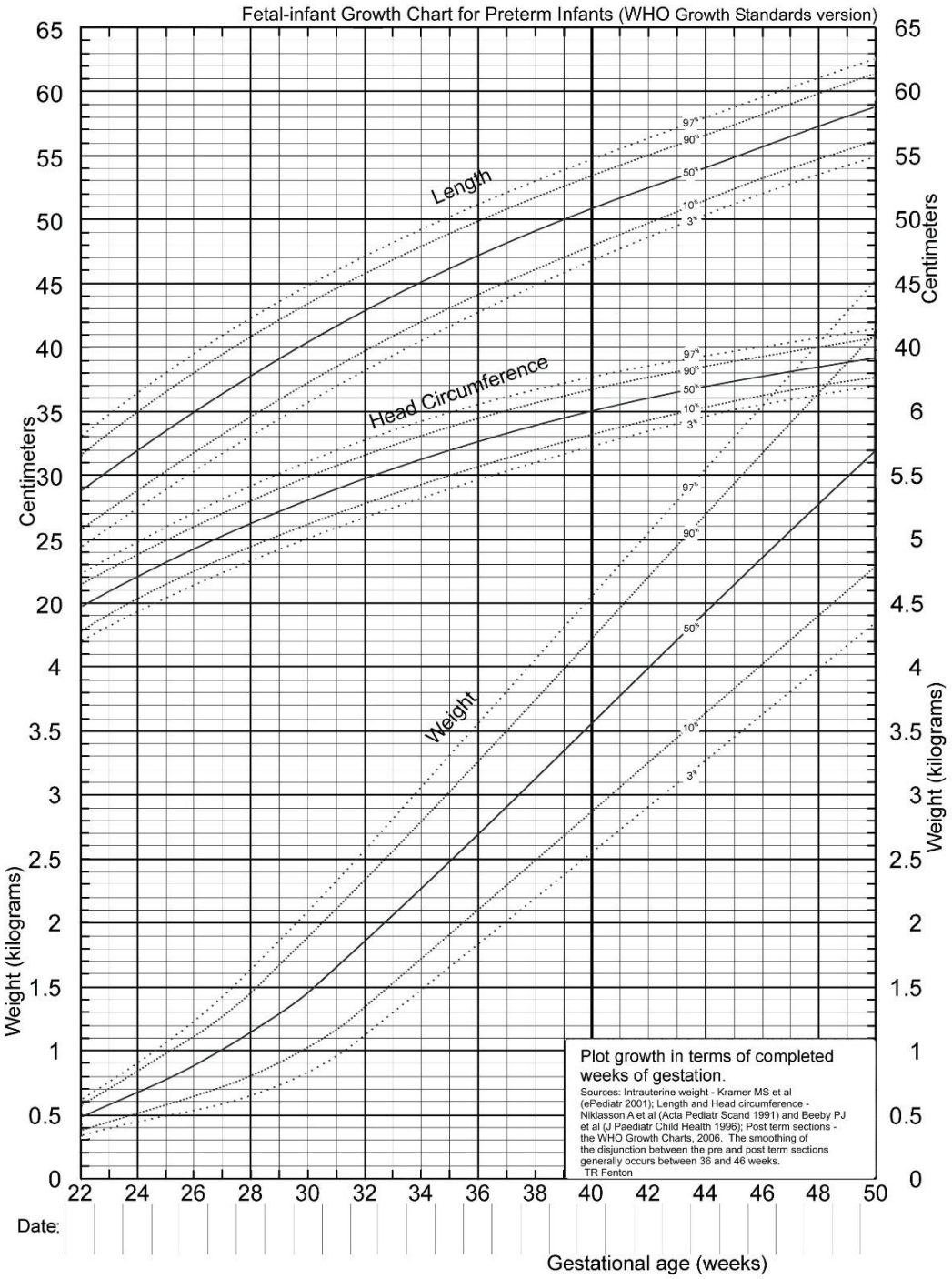

Fig. 4: Fenton (preterm) growth chart

Length

Length of the newborn is measured as crown heel length. In a term infant normal limit varies from 48-53 cm. Infants length is measured by infantometer. Infantometer should be placed over the table or any firm surface. Infant should be nude or with minimal dressing placed over the infantometer with head straight and eyes perpendicular to the surface. Following which measurements are documented. The length of the newborn should be plotted in sex specific growth charts.

Head circumference

It is the occipital-frontal circumference measured using non-stretchable measuring tape. Maximum-Circumference should be measured from the supraorbital ridge to the occipital protuberance using crossed-tape method.

In a term newborn HC ranges between 33-35 cm. It should be plotted in the sex specific WHO growth chart against the gestational age. Normally HC increases by 2cm/month for first 3 months then 1cm/month next 3 months followed by 0.5cm/month till 1 year of age.[85]

When then measured head circumference is below the 3rd percentile they are classified as Microcephaly and it is two different types, essential and optional microcephaly. The HC is more than 97th percentile they are classified as macrocephaly.[86]

Ponderal Index[87]

Growth in utero is affected by various factor and they are dependent on the time and duration of exposed risk factor. Based on ponderal index nutrition status is classified into 3 types.

Type 1- symmetric IUGR; infants are noted to be small with propionate weight, length even head circumference. This is found in babies born to mothers who are malnourished before pregnancy and during pregnancy.

Type 2 - asymmetric IUGR; it is disproportionate form of malnutrition were weight is more affected than than length and head circumference. This type is IUGR is found in infants with malnutrition during last weeks of pregnancy.

Type 3 – no IUGR; were newborn has weight, length and head circumference are normal and proportionate for the gestational age.

Ponderal index is calculated using formula

$$\text{Ponderal Index} = \frac{\text{Birth weight (in g)}}{length\ @\ birth(in\ cm)^3} \text{ x } 100.$$

CLINICAL ASSESSMENT OF NUTRITIONAL SCORE-CANSCORE

CANSCORE was developed by Reba Michels in a systematic way for the assessment of nutritional status, which was previously described by Metcoff using superficial signs of malnutrition in the newborn. They have 9 different parameters with each scoring from 1 to 4 so the total score ranges from 9 to maximum of 36. The cutoff for fetal malnutrition is 25, so 9-24 is malnutrition and 25 to 36 is considered as well-nourished fetus.[5]

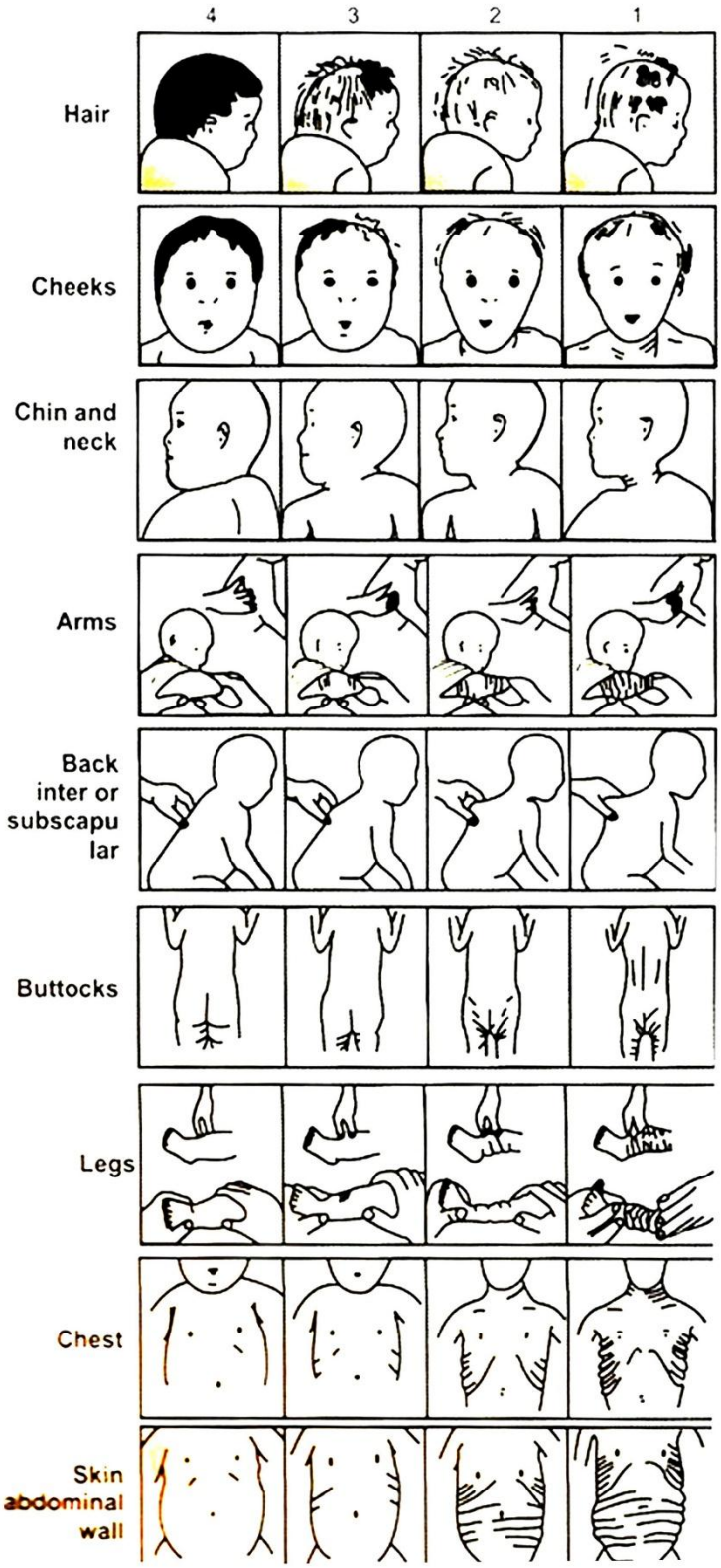

Fig. 5: CANSCORE system (1-9 criteria)[5]

Table 4: The CANSCORE and its parameters[5]

Parameters	Score 1	Score 2	Score 3	Score 4
1. Hair	Less abundant or thin, flag sign	Less abundant, coarse, straight, which does not respond to brushing	Thinner, some straight 'starting' hair.	Large amount; smooth, silky, easily groomed.
2. Cheeks	Reduced buccal fat with narrow flat face.	Flat, poor or small pad of fat.	Flat good pad of fat.	Round, large, fat pad.
3. Chin and Neck	No submandibular fat; thin chin, neck with loose, wrinkled skin very evident	No double chin, some submandibular fat, minimal neck fat.	Full, submandibular fat, moderate neck fat, with moderate neck fat within clearer, no rolls.	Double or triple neck fat roll, neck not visible.
4. Arms	Sub-cutaneous tissue minimal, skin very loose in appearance, easily grasped and pulled away from the elbow.	Some sub-cutaneous tissue present on upper and lower skin, skin loose, pleats easily, can pick up over elbow but not on back of the hand and forearm.	Moderate and subcutaneous tissue present on upper and lower arms, slight pleating of skin, cannot pick up over elbow back of hand.	Upper and lower skin thick, subcutaneous tissue taught, cannot pick up over elbow, back of hand.
5. Back skin sub-scapular areas	Subcutaneous tissue minimal, skin very loose in appearance, easily tents over scapular, spine, lower back.	Some subcutaneous tissue skin loose over scapula and lower back.	Moderate subcutaneous tissue present loose over scapula.	Upper and lower skin thick, subcutaneous tissue, difficult to grasp and lift skin in the inter-scapular area.

6.Buttocks fatness	Flat, wasted appearing, little or no fat.	Flat (not full) but definite fat present.	Round, less full, less firm.	Round, full firm.
7.Legs: Skin	Upper thighs appear wasted obvious loose skin over medial thighs, easily picked up and pleats over upper and lower leg; easily picked up over knee, very poor turgor.	Skin upper medial thigh loose, skin easily picked up over anterior thigh but not over tibia, barely over knee.	Some subcutaneous tissue, can pick up easily but good turgor.	Thick subcutaneous tissue that can pick up over anterior thigh and anterior tibia.
8. Chest and ribs	Prominent ribs: Obvious loss of intercostal tissues.	Prominent ribs: Some intercostals tissue.	Intercostal spaces prominent, ribs obvious.	Round ribs not seen: Intercostal space concave.
9. Abdomen	Distended or scaphoid; but with very loose skin, easily lifted and wrinkled.	Scaphoid but not very loose skin easily lifted and with some wrinkles.	Round with loose skin, not easily lifted with no wrinkle.	Full round, not loose skin.

Fetal Malnutrition (FM)

Fetal malnutrition is a clinical state were the infant born of any birth weight in respective to gestation age has a nutrition insufficiency in-utero, which has a higher risk of perinatal morbidity and mortality.FM is usually missed by other method of anthropometric indices, but easily recognized by simple clinical examination with the need of any instruments.

FM affects various tissues of the body by reducing the protein content and muscle mass, organ development and bone formatting, which also has an effect on metabolic & enzymatic function of the body.

Clinically FM is characterized by loss or failure in acquiring normal amount of fat subcutaneously and protein during intra-uterine gestation were the weight, fetal length is not much affected. So FM may be found in any newborn irrespective of weight/ IUGR status.

CAUSES OF FETAL MALNUTRITION

There are many factors contributing fetal malnutrition and growth failure during intra-uterine period. Some of them may even be physiological.

The major factors contributing fetal malnutrition are listed in two different groups, as physiological and pathological.[88]

Table 5: Causes of fetal malnutrition

PHYSIOLOGICAL FACTORS	
Maternal	
Short mother has constraints fetal growth	Grand multi-parous and primi-parous mother have small babies
Maternal age < 20 or > 35 years	Low pre-pregnancy weight and BMI with poor weight gain during pregnancy.
Fetal	
Girls are smaller than boys at birth	Multiple factors
Inherited genetic potency	Twin pregnancy

PATHOLOGICAL FACTORS	
Maternal	
Utero-placental insufficiency	Irradiation
maternal Chronic illness and drugs	Aberrant cord insertion
Under-nutrition	Premature separation of placenta
Smoking and alcohol	Placental hemangiomas
Fetal	
Chromosomal anomalies	Intrauterine infections
Congenital malformations	Endocrine disorders
Placental	
Decreased placental cellularity and weight	Villous placentitis
Infraction	Tumors
Twin to twin transfusion	Decreased surface area
Environmental	
High altitude	Toxins; eg. methyl mercury
Idiopathic growth failure	

1. Maternal malnutrition

Incidence of SGA and LBW babies are high in developing countries which is highly related to SES, maternal illness and increased frequency of pregnancy with malnutrition. Some studies have proved small mother like mother height <145cm/ weigth <40kg have increased risk of giving birth to small babies. These babies may grow small in later age due altered growth potency.[89,90,91,92]

Shahla Y et al. (2012) did a study on 1000 pregnant women were study shows women with above normal BMI had higher incidence of pre- eclampsia, needing

induction of labour and caesarean section with increased incidence of preterm labour, macrosomia and adverse pregnancy outcomes.[94]

Anjana Verma et al. (2012) conducted a study among 784 women by categorizing them into 5 group based on BMI were underweight mother noted to have high incidence of anemia with growth retardation and SGA babies. On other side overweight and obesity group had high incidence of PIH, GDM, LGA babies. Thus more care should be given on health of childbearing women to have a better pregnancy outcome.[95]

Jain deepika et al. (2012) did an observational study 300 nulliparous women were maximum patents underwent LSCS were overweight and obese and they had high risk of PIH, GDM and PPH with high incidence of Large babies (>4kg) on other side women with BMI less than normal had high incidence of SGA babies when compared to Normal BMI population.[96]

Hamideh Pakniat et al. (2015) underwent a cohort study on 1376 pregnant women to find the impact of MBI on pregnancy outcome. Where she noted preeclampsia, GDM, PIH, need of LSCS and big babies are more common in overweight and obese women. Thus the study concludes the need of pre pregnancy weight monitoring for better pregnancy outcome.[97]

Rajesh KR et al. (2017) did a survey on pregnant women in which they noted overweight, obese and underweight mother had higher odds of neonatal mortality when comparing to normal BMI mother thus his survey concludes the need of pre pregnancy counselling regarding the maternal nutrition to improve the pregnancy outcome.[117]

2. MATERNAL DISEASE STATES

Several maternal medical conditions can lead to IUGR. Example in chronic hypertensive mother there is reduced uteroplacental perfusion leading to IUGR. It is noted that reduced availability of oxygen like severe anemia, CCHD can also lead to IUGR.[52,93]

Poor fetal outcome is also found in babies born to mother with vascular diseases like chronic hypertension, PIH, uncontrolled diabetes mellitus with micro and macro vasculopathies, chronic kidney disease, SLE and finally antiphospholipid syndromes etc.[6]

Asthma

Schatz et al. (1995) did a study of pregnant women with asthma, study concluded that maternal asthma are at high for preeclampsia, perinatal mortality, preterm birth and LBW and congenital malformation and incidence of LBW is much more high in women living in high altitude with chronic hypoxia.[98]

Schatz M (2009) stated that immunological and clinical changes are characterized only in the mother only it doesn't affect the fetus still sever complication are seen in like prematurity, LBW babies and these are complication are noted more in uncontrolled asthmatic women during pregnancy.[99]

Clark et al. (1993) conducted a cohort study in pregnant asthmatic women, were risk of congenital malformation in CNS (except spina bifida), respiratory and digestive system was noted in babies born to asthmatic mother but still data are not consistent regarding congenital malformation.[100]

Meena BL et.al (2013) underwent a study in 2400 pregnant women in which prevalence if asthma was 2.1% in which 48.1% were in intermittent asthma and remaining are in persistent asthma group and poor pregnancy outcome was noted in uncontrolled and symptomatic asthmatic mother.[101]

GDM

Amanda l et al. (2016), did a retrospective cohort study on pregnant women with GDM, where the complication like LGA, preterm labour ever SGA are seen but these complication are highly dependent upon the therapies underwent by the mother during pregnancy. The mother treated with insulin noted to very less chance of going in for preterm labour on other side mother receiving metformin had less chance of giving birth to SGA babies. But still complication faced by the paediatricians in labour room is still high.[102]

Heart Disease

Indra I et al. (2015) conducted a study on maternal heart disease in which incidence was 0.43% and rheumatic heart disease complicated by mitral stenosis was the most common problem followed by congenital heart disease mainly atria septal defect. Maternal complication including death was noted in 6% of population and fetal complication like IUGR and preterm labour was noted in mother of NYHA class III and IV. Complication was less likely in mother of NYHA class I & II.[103]

Konar et al. (2012) did a review on 281 women with heart disease during pregnancy, were incidence of rheumatic heart disease was 69.4 % followed by septal diseases and ischemic heart diseases in which maternal and fetal complications like IUGR and preterm was seen in babies born to unbooked mother and on poor follow up.[104]

Hema Priya et al. (2017) conducted a study on 72 pregnant women and reported incidence of rheumatic heart diseases during pregnancy was 1.72% and it is more prevalent in low socio economic status and rural population. Mother with poor functional class are noted to have poor pregnancy outcome with ~30% of babies were noted to be LBW hence early diagnosis and cardiac follow is needed for good pregnancy outcome.[105]

Kurra SP et al (2017) did a study on pregnant women with heart disease on 32 women were observed incidence of heart disease during pregnancy was 0.21% and pregnancy was complicated in form preterm and LBW babies with increased need for NICU admission thus mother with cardiac disease needs a multidisciplinary teamwork for good pregnancy outcome.[106]

Srinivasa Rao et al (2013) did a study in first trimester during pregnancy and study reviled prevalence of anemia was 93.26% and microcytic hypochromic anemia was the most common type of all.[107] Similar kind of study was conducted by Abisevi et al (2017) where 41.5% of the women was anemic and again iron deficiency anemia is commonest of all.[108]

Rahmati Sh et al (2016) underwent a systemic review on 30 studies in which anemia in the first trimester had significant relation with pregnancy outcome like IUGR, LBW, and pre-term labour. Tough anemia in second and third trimester have an impact on pregnancy outcome which is significantly low on comparing with first trimester anemia.[109]

Rima I et al (2016) did a study in pregnant women with hypertension and its impact on fetus. Women with PIH had high risk for LBW, SGA and IUGR due to

hypoperfusion and need for NICU admission and duration of hospital stay was prolonged.[110]

3. MATERNAL DRUG EXPOSURE

Though maternal consumption of alcohol is less common, few studies have shown 10% offspring born to moderate alcoholic mother have features of fetal alcohol syndrome.[111] It is characterized by Abnormal facies, IUGR, CNS dysfunction. Presence of clinical features is highly dependent on dose of alcohol consumed.

Some other drugs like cocaine also has effect on infant, and it is noted 25-30% babies born to mother using cocaine pregnancy had IUGR babies.[7]

And use of heroin during pregnancy has 3 times the risk of giving birth to IUGR babies than general population.[112] Tobacco, either active smoking or passive smoking has an increased risk of IUGR.

4. CONGENITAL MALFORMATION AND IUGR

Infants with chromosomal anomalies and other malformation like congenital heart disease, neural tube defects with other dimorphic syndromes has an increased risk for IUGR babies.

Muin et al. in his study found that all forms of congenital malformation are with increased risk for IUGR. Among all congenital malformation babies 22.3% were noted to born IUGR at birth where as it is only 10% in general population. So the calculated risk of IUGR is increased from 3.3% to 8 % in presence of congenital malformations.[113,114]

5. GENETIC AND DEVELOPMENTAL INFLUENCES

The chromosomal anomalies like trisomy 21, 13, 18 and turners syndrome are noted small for gestational age/ LBW/IUGR/when compared with normal babies. And Other chromosomal abnormalities like deletion, duplication & translocation have variable effects on intra-uterine fetal growth, which depends upon the affected chromosome.[2,98]

6. CONGENITAL INFECTIONS

Infection during pregnancy has variable effects on the developing fetus. 1st trimester infection can disrupt organogenesis. Most infection in TORCH S ("Toxoplasma, Rubella, CMV, Herpes simplex, Syphilis") may lead to variety of syndromes along with IUGR.[2,75,115]

7. TWIN PREGNANCY

During twin pregnancy both the fetus may get adequate nutrition upto 35 week of gestation but beyond this single placenta is less likely to provide nutrition to both the fetus.

8. SEX

Female infants are noted to have less weight than the male counterpart.

9. ALTITUDE

Mother living at high altitude (>10,000ft) are more likely to give birth to SGA/LBW babies due fetal hypoxia.[116]

CHANGES IN BODY COMPOSITION WITH FETAL MALNUTRITION.[22,75]

One in every three LBW babies are observed to have FM seaquelae. And these FM babies are noted to have chemical, metabolic and neurodevelopmental variation as compared with normal infants.[5]

Changes are noted in Placenta, Liver, Heart, .Muscle growth, Brain development and Water balance.

Table 6: Biochemical and metabolic changes in malnourished/SGA

Protein and Collagen	• Ammonia, • Urea, • Uric acid • Hydroxypro line turnover early; • Later • Uronic acid turnover • No change in total protein • No change in prealbumin • IgG/ IgM in some
Immuno-competence	• Humoral/cellular bactericidal capacity • phagocytic index • Lysozyme • Humoral and cellular immuno competence
Hematology	• Hematocrit; RBC volume; HbF; EPO viscosity, platelets • PT, APTT • No change in reticulocyte count (% or absolute); but increased reticulocyte index • Hematocrit; RBC volume; HbF; EPO viscosity, platelets • PT, APTT • No change in reticulocyte count (% or absolute); but increased reticulocyte index

Carbohydrate and fat metabolism	• Fetal or neonatal hypoglycemia • No change or glucose Kt / or no change in insulin • Low urinary adrenalin after hypoglycemia or no change in b-hydroxybutyrate • No change or ed ketone bodies / or no change in FFA and glycerol hepatic gluconeogenic lactate and pyruvate-alanine / Glucogen
Others	• Serum Ca2+ • No change in amniotic fluid L-S ratio Transient diabetes cortisol / 11-OH corticosteroids • No change / HGH or no change in O2 consumption

IMMEDIATE EFFECTS OF FETAL-GROWTH RETARDATION

Antenatal and perinatal complications

It is noted perinatal death risk increases by 8 times in newborn with intra uterine growth retarded. Infants of 1.5 to 2.5kg have 5-30times increased risk of perinatal mortality and it increases by 70-90 time if born below 1.5kg at birth.[118]

IUGR babies are likely to have fetal distress during labour followed by acidosis at birth.[119] Meconium staining and meconium aspiration are common in IUGR babies by 34 weeks of gestation.

On other hand, preterm delivery is more common with IUGR infants, and they are relatively more prone for RDS and IVH.[120]

Due to decreased subcutaneous fat in term IUGR babies they are more prone to develop hypothermia with increased risk of polycythemia by 10-15 times.[121] Common effects of FM are,

Table 7: Effects of fetal malnutrition

NEONATAL PERIOD	
Still birth	Fetal distress
Perinatal asphyxia	Intraventricular hemorrhage
Meconium aspiration syndrome	Sensoroneural injury
Hypothermia	Necrotizing enterocolitis
Hypoglycemia	Cholestatic liver disease
Polycythemia	Nutrient deficiency
INFANCY	
Sudden infant death syndrome	Extra uterine growth retardation & growth failure
Delayed eruption of teeth	Delayed cellular and humoral immunity
Developmental delay	Neurological deficit

MATERIALS & METHODS

The current study is a hospital based cross-sectional study done on 84 singleton newborn babies delivered Sree Mookambika Institute of Medical Sciences, Kulasekharam with in duration of 18 months.

SAMPLING

Total no of group included **:** 1

Sample size of each group **:** 84

Total sample size of the study **:** 84

Scientific basis of sample size used in the study:

Sample size (n) = $4pq/d^2$,

Where, p = prevalence

q = 100– prevalence

d = precision is 10%

Substituting in the formula, (n) = $4pq/d^2$

P = 30[21]

= $(4*30*70)/10^2$

= 8400/100 = 84

The sample size was calculated to be: 84

Sampling technique: Purposive sampling of all consecutive cases.

Inclusion criteria:

- All live - new born of gestational age above 34 weeks delivered in Sree Mookambika institute of medical sciences were included .
- Known gestational age by last menstrual period.
- Only neonates whose hospital stays exceeded 24 hours of age.

Exclusion criteria:

- Newborns whose parents are not willing for this study.
- Mother with no record of previous AN checkup and previous weight of the mother.
- Newborn with gestational age less than 34.
- Major congenital malformation and chromosomal defects.
- Newborn's hospital stay less than 24 hours.
- Newborn who could not be examined due to medical complication in NICU.

MATERIAL USED

- Electronic weighing machine – Phoenix (India)
- Non stretchable, flexible measuring tape – Butterfly (India)
- Infantometer – Galaxy (India)

METHODOLOGY

- Institutional research and ethical committee clearance obtained, following informed consent obtained from the mother.
- Newborn's general information is filled in the standardized proforma soon after delivery which is made available in newborn unit.
- Maternal details taken from the mother case sheet which includes age, consanguinity, obst scoring and birth order, LMP to calculate gestational age (confirmed by The new Ballard Score), records of maternal anthropometry (weight and height) in first trimester to calculate BMI and maternal medical condition with SES.

- Baby's birth details like Date of Birth, Time of Birth and APGAR and need of neonatal Resustation were enrolled in the proforma. Following which gestational age was estimated using The New Ballard Score and Anthropometric measurements and CANSCORE were recorded using standardized technique as followed.

ANTHROPOMETRIC MEASUREMENTS

1. BIRTH WEIGHT:

The Naked birth weight is measured immediately after birth using electronic weighing scale and plotted in WHO Growth curve and based on which babies are classified as AGA, SGA and LGA.

2. CROWN HEEL LENGTH:

The naked baby is placed supine in Infantometer with full extended knees and sole of feet held firm against the foot board with head held firmly against the fixed board. Then the measurement is noted and plotted in the WHO Growth curve.

3. HEAD CIRCUMFERANCE

Using the standard, flexible and non-stretchable measuring tape by cross tape method circumference encircling the occipital prominence, supra-orbital is measured and documented.

PONDERAL INDEX

Ponderal index is calculated using formula weight (grams) /length (cm) ^{3} and newborns are classified as malnourished with the cut-off <2.2. [122]

BMI

Babies BMI is calculated using formula weight (kg)/ length (meter)^2 and based on BMI newborns are classified as malnourished with cut-off <11.2 kg/m^2.[123]

THE NEW BALLARD SCORE

The new Ballard score was performed on all the new born with in 30 min to 24 hours for the estimation of the gestational age which is compared with the gestational age calculated by LMP.[82]

CLINICAL ASSESSMENT OF NUTRITIONAL SCORE – CANSCORE.

CANSCORE was performed within 24-48 hours after birth, based on the total score they are classified as fetal malnourished and well-nourished with cut-off as <25 and >25 respectively.[5]

STATISTICS AND DATA ANALYSIS

All these data were enrolled in Microsoft Excel sheet 2013 and the data is transferred to SPSS (version 20.0). Using SPSS, statistical analysis done with the p value <0.05 was considered significant. And standard deviation, mean, median, mode were identified and the results are represented in table, Bar diagram and pie charts.

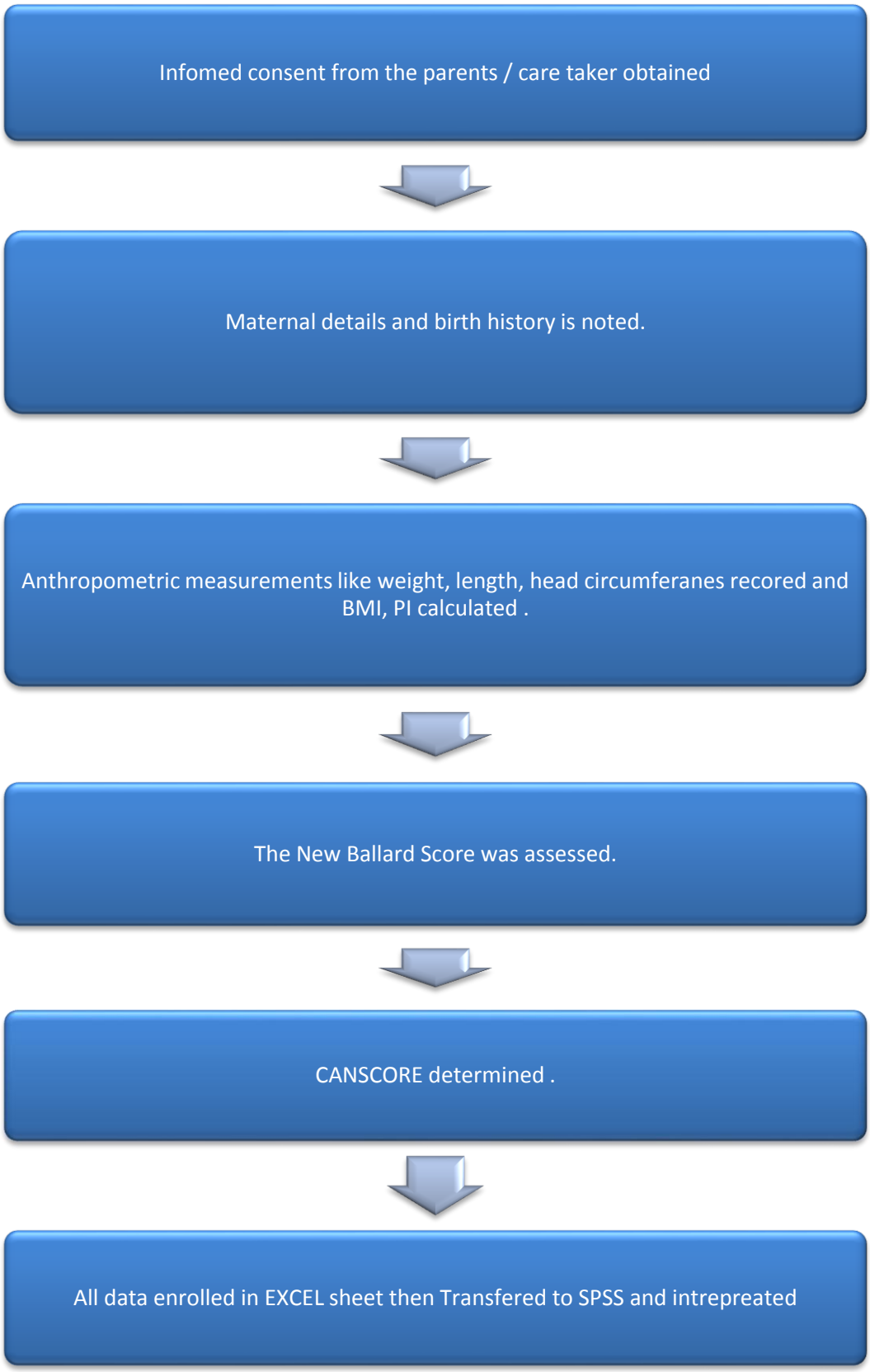

Fig. 6: Methodology.

RESULTS

RESULTS AND OBSERVATIONS

The present study on 84 newborn data's was tabulated and analyzed using SPSS. Having CANSCORE as gold standard tool for identification of Fetal Malnutrition these results are tabulated.

Table 8: Distribution of newborn according to sex

	Male	Female	Total
No. (%)	45 (53.6%)	39 (46.4%)	84 (100%)

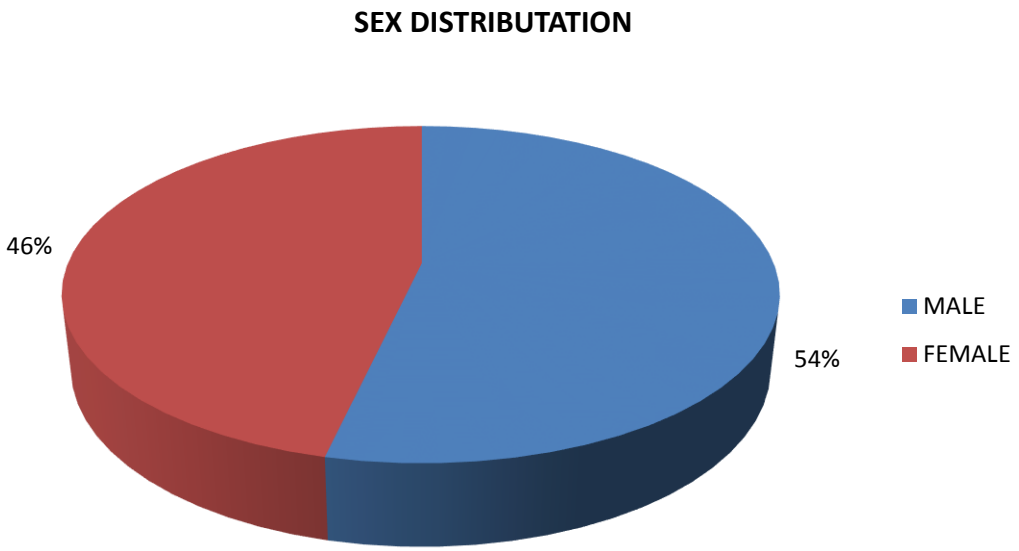

Fig. 7: Distribution of newborn according to sex

In the present study out of 84 newborn babies, 45 (53.6%) were male and 39 (46.4%) were female babies.

1. DESCRIPTIVE STATISTICS OF ANTHROPOMETRIC VARIABLES & CANSCORE

BIRTH WEIGHT

Distribution of birth weight in newborn babies ranges from 1.50 to 3.20kg with mean of 2.3833 ± 0.205kg.

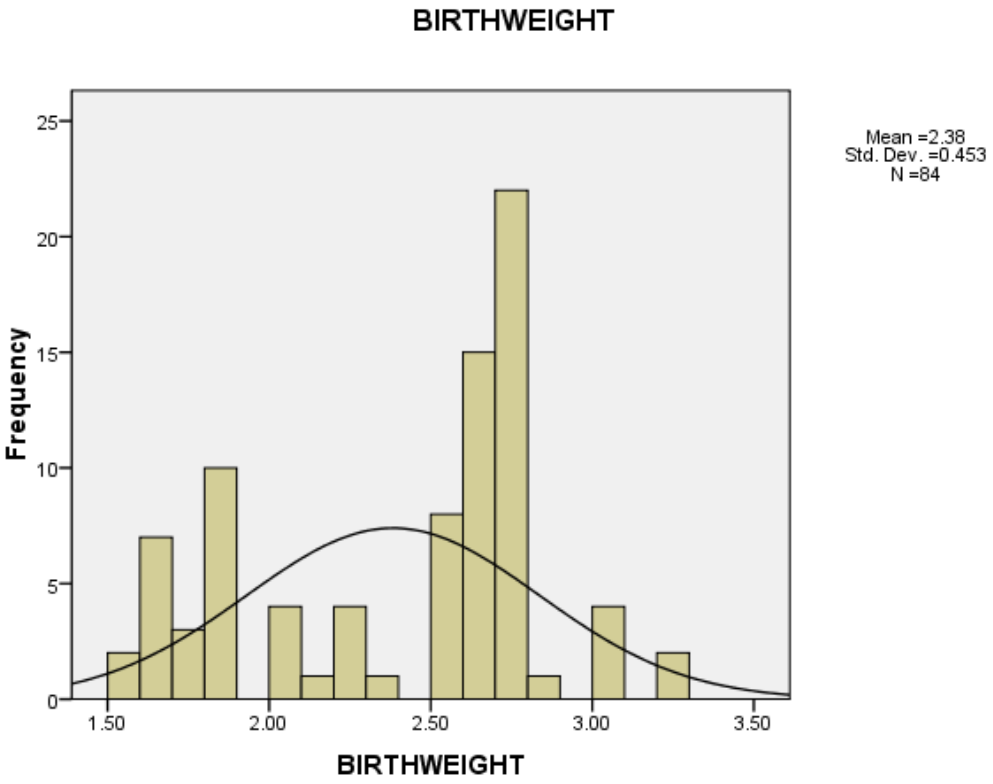

Fig 8: Distribution of birth weight

LENGTH

Distribution of length in newborn babies ranges from 41.5 to 52.0 cm with mean of 6.533 cm.

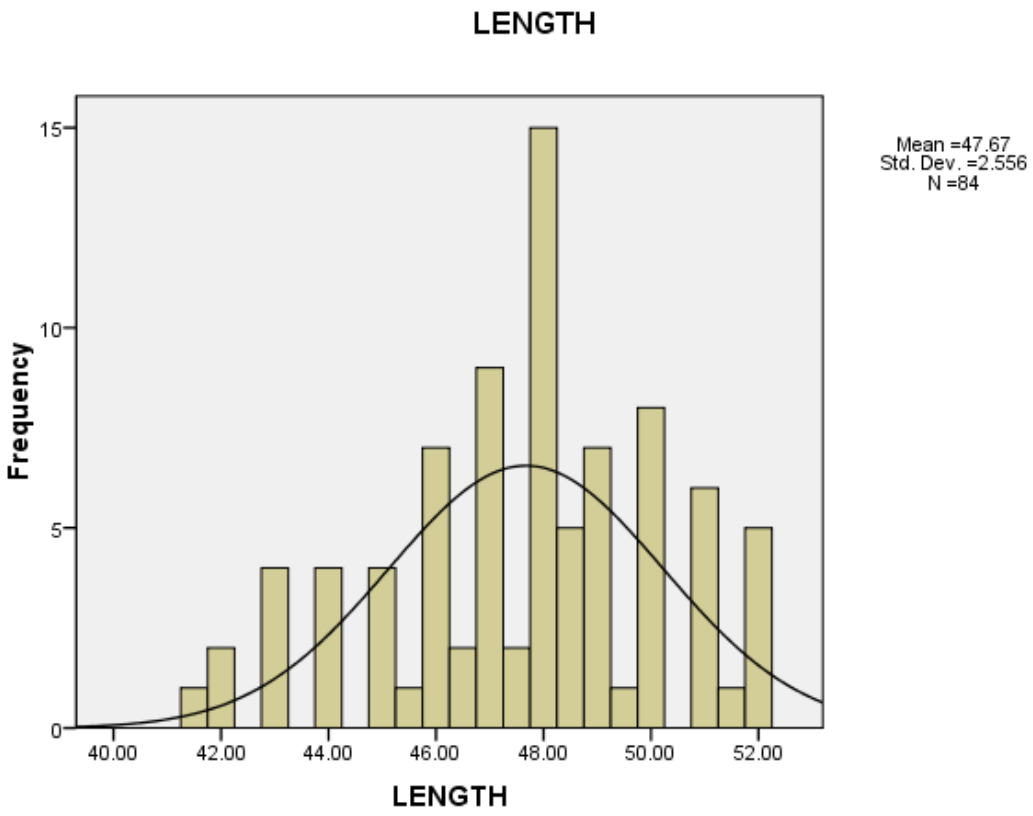

Fig. 9: Distribution of birth-length

HEAD CIRCUMFERANCE

Distribution of head circumference in newborn babies ranges from 29.0 to 52 cm with mean of 1.716 cm.

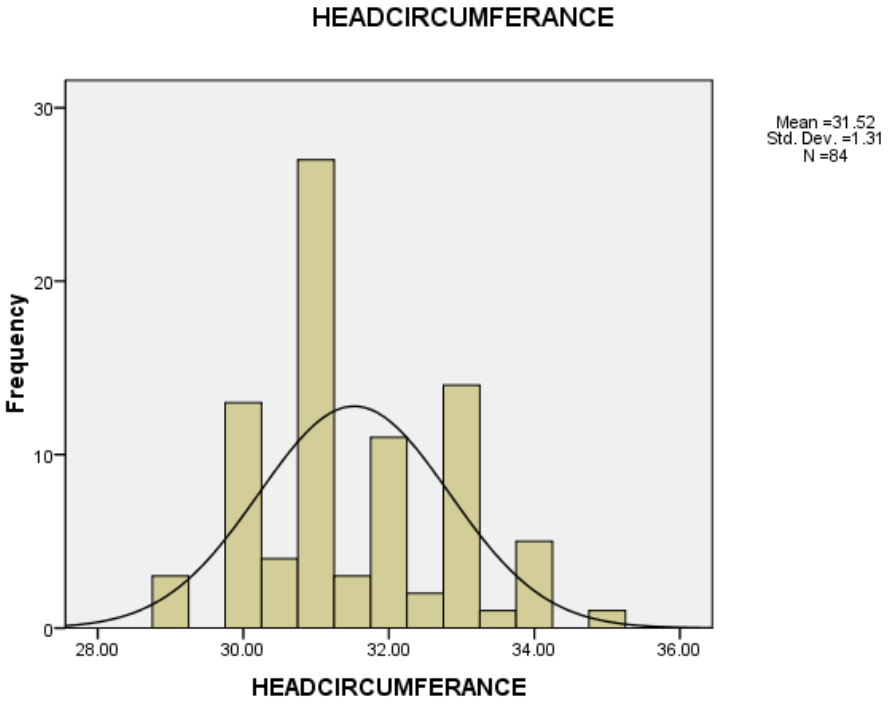

Fig. 10: Distribution of Head circumference

BMI

Distribution of neonatal BMI in newborn babies ranges from 7.6 to 15.10 with mean of 1.9.

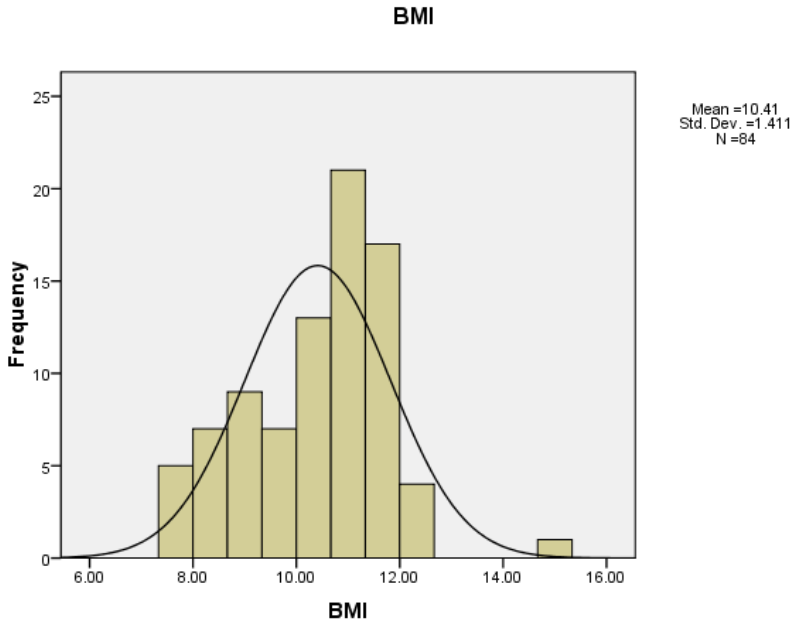

Fig. 11: Distribution of babies according to babies' BMI

PONDERAL INDEX

Distribution of Ponderal index in newborn babies ranges from 1.50 to 2.50 with mean of 0.063.

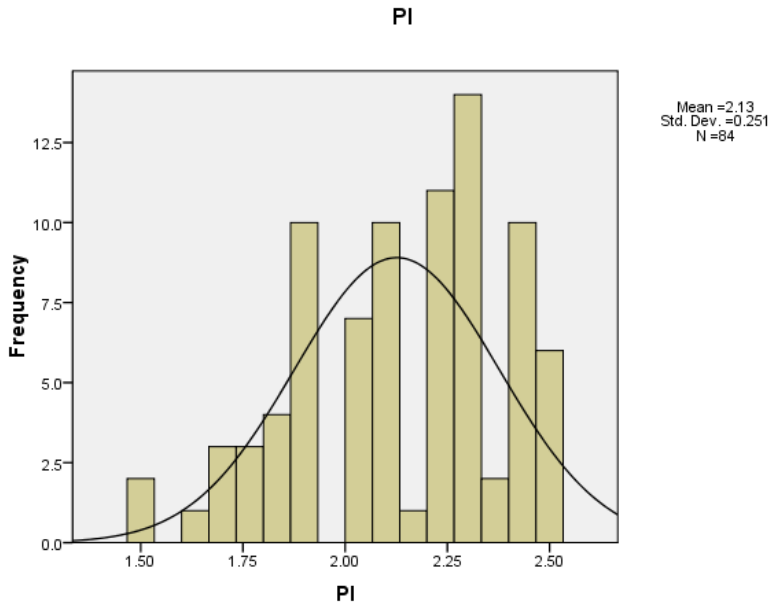

Fig. 12: Distribution of babies according to Ponderal Index

CANSCORE

Distribution of CANSCORE in newborn babies ranges from 16.0 to 33.0 with mean of 1.64.

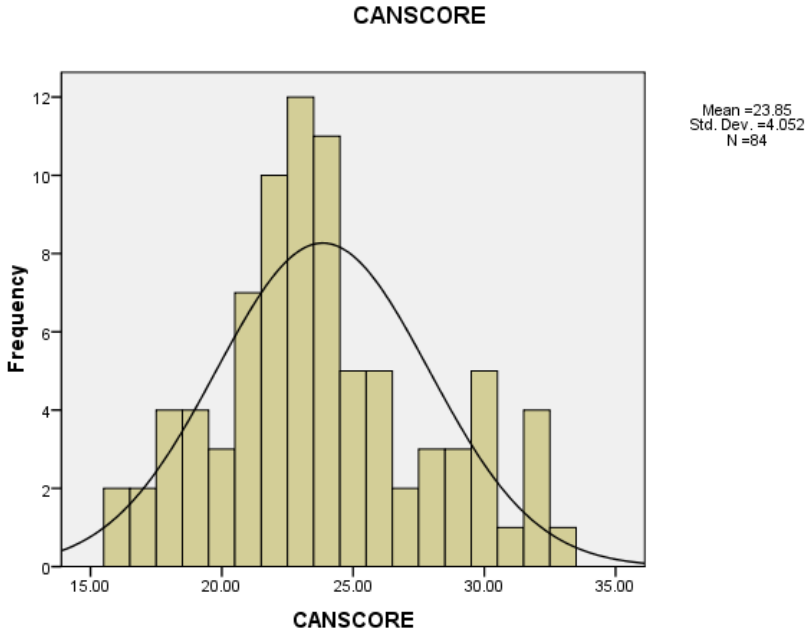

Fig. 13: Distribution of babies according to CANSCORE

Table 9: STANDARD DEVIATION OF ANTHROPOMETRIC VARIABLE AND CANSCORE

Statistics	Birth weight	Length	Head circumference	BMI	PI	CANSCORE
Total	84	84	84	84	84	84
Mean	2.3833	47.6726	31.5238	10.4119	2.1263	23.8452
Median	2.5522[a]	4.7912E1[a]	31.2833[a]	1.0720E1[a]	2.1636[a]	23.3478[a]
Mode	2.60	48.00	31.00	11.30	2.20[b]	23.00
Std.Deviation	.45307	2.55599	1.31007	1.41058	.25085	4.05235
Variance	.205	6.533	1.716	1.990	.063	1.6422
Range	1.70	10.50	6.00	7.50	1.00	17.00
Minimum	1.50	41.50	29.00	7.60	1.50	16.00
Maximum	3.20	52.00	35.00	15.10	2.50	33.00

B. DISTRIBUTION ACCORDING NEONATAL PARAMETERS

Table 10: Distribution of newborn according to gestation age

Sex	Term No. (%)	Preterm No. (%)	Total No. (%)
FEMALE	33 (84.6%)	6 (15.4%)	39 (46.4%)
MALE	41 (91.1%)	4 (8.9%)	45 (53.6%)
Total	74 (88.1%)	10 (11.9%)	84 (100%)

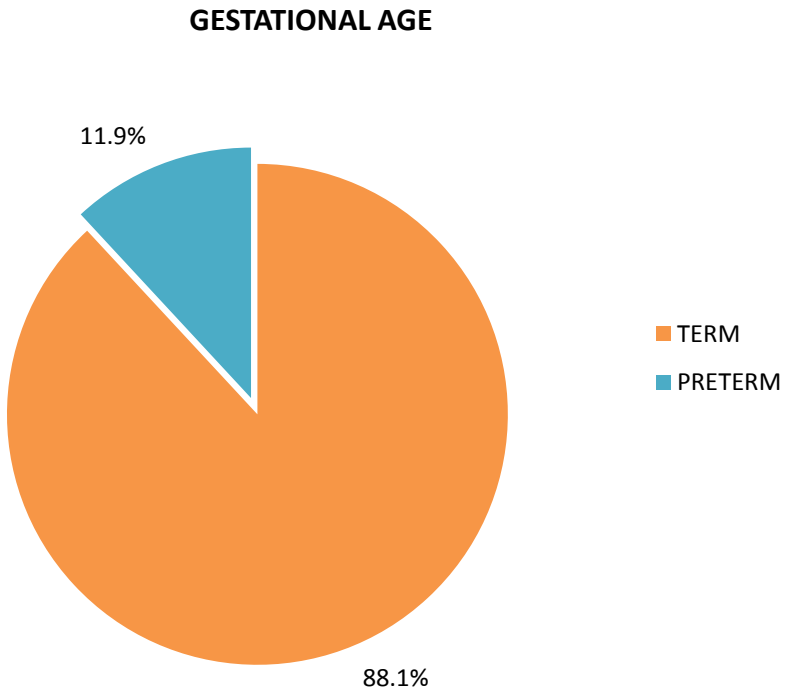

Fig. 14: Distribution of newborn according to gestation age.

Out of 84 newborn babies, 74 (88.1%) were born in term gestation and 10 (11.9%) were born preterm.

Table 11: Distribution of newborn according to weight for gestational age

SEX	AGA No. (%)	SGA No. (%)	Total No. (%)
FEMALE	25 (64.1%)	14 (35.9%)	39 (46.4%)
MALE	27 (60%)	18 (40%)	45 (53.6%)
Total	52 (61.9%)	32 (38.1%)	84 (100%)

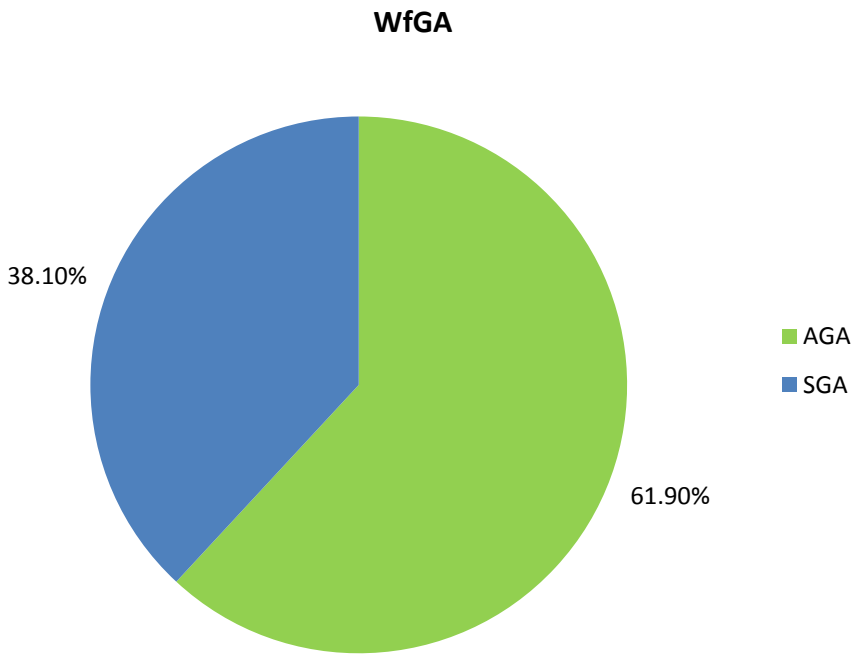

Fig. 15: Distribution of newborn according to weight for gestational age

In the present study, out of 84 newborn 52 (61.9%) were born AGA and 32 (38.1%) as SGA with no LGA babies

Table 12: Distribution of newborn according to nutritional status by CANSCORE

	Malnourished CANSCORE<25	Well Nourished CANSCORE >25	Total
No. (%)	55 (65.5%)	29 (34.5%)	84 (100%)

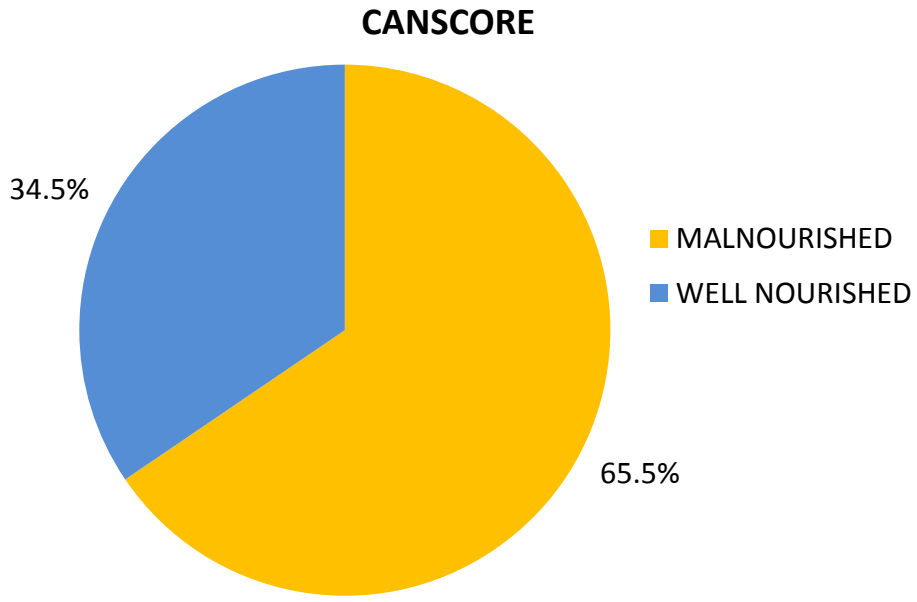

Fig. 16: Distribution of newborn according to nutritional status by CANSCORE

Out of 84 newborn babies 55 (65.5%) babies had fetal malnutrition - CANSCORE <25 and 29 (34.5%) were well nourished - CANSCORE >25.

Table 13: Distribution of newborn according to nutritional status by BMI

	Malnourished BMI <11.2	Well Nourished BMI >11.2	Total
No. (%)	55 (65.5%)	29 (34.5%)	84 (100%)

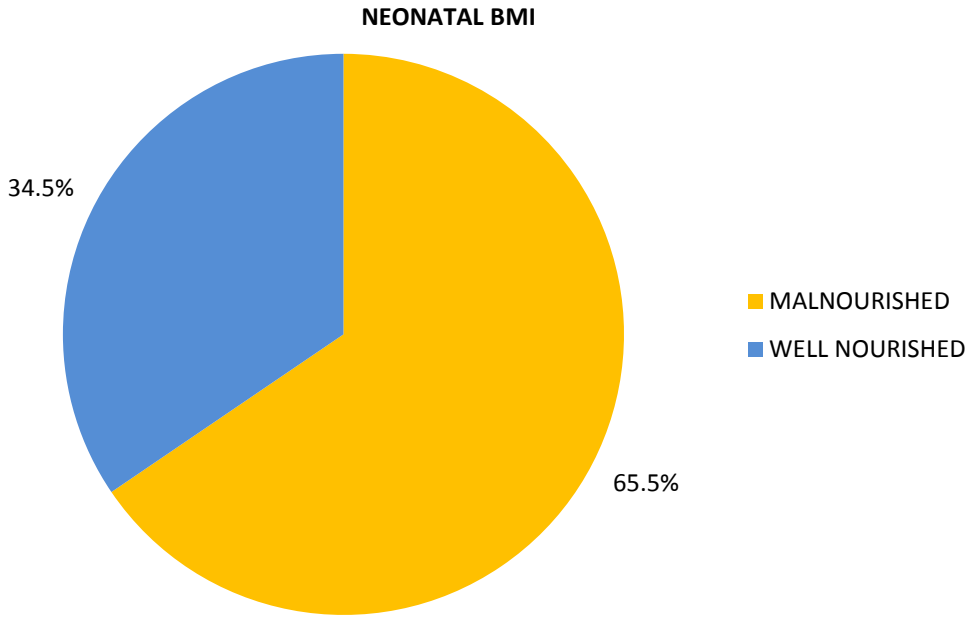

Fig. 17: Distribution of newborn according to nutritional status by BMI.

Out of 84 newborn babies 55(65.5%) were classified as malnourished and 29 (39.3%) as well nourished by BMI with cut-off of 11.2kg/m^2

Table 14: Distribution of newborn according to nutritional status by Ponderal Index

	Malnourished PI <2.2	Well Nourished PI >2.2	Total
No. (%)	51 (60.7%)	33 (39.3%)	84 (100%)

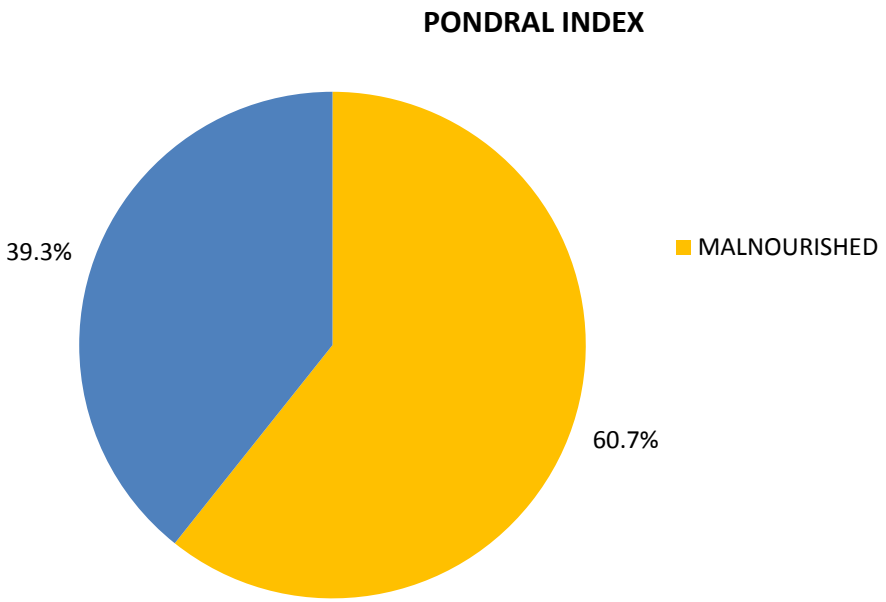

Fig. 18: Distribution of newborn according to nutritional status by Ponderal Index

Out of 84 newborn babies 51 (60.7%) was classified as malnourished and 33(39.3%) as well nourished by PI, with cut-off of 2.2.

C. DISTRIBUTION ACCORDING TO MATERNAL PARAMETERS.

Table 15: Distribution according to maternal age.

MATERNAL AGE	<20 YEARS	>20 YEARS	Total
No. (%)	35 (41.7%)	49 (58.3%)	84 (100%)

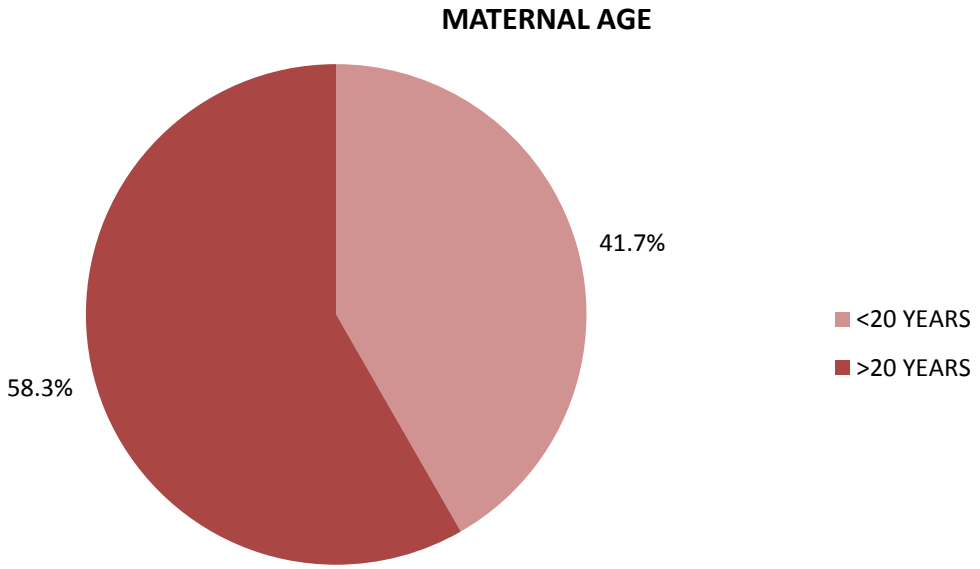

Fig. 19: Distribution according to maternal age.

Out of 84 babies, 35(41.7%) were born to mothers less 20 years of age and remaining 49 (58.3%) were born to mother age above 20 years.

Table 16: Distribution according to maternal parity

GRAVIDA	PRIMIGRAVIDA	MULTIGRAVIDA	Total
No. (%)	55 (65.5 %)	29 (34.5%)	84 (100%)

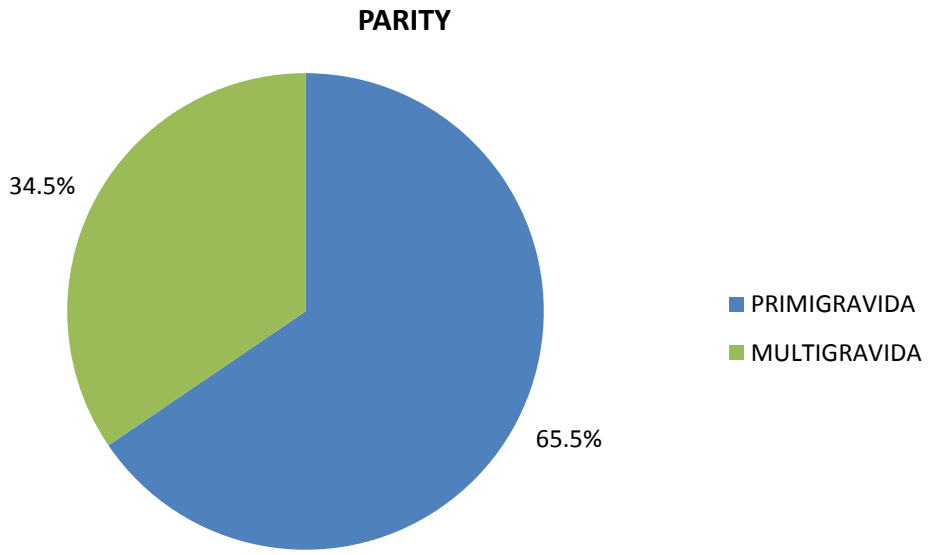

Fig. 20: Distribution according to maternal parity

Out of 84 newborn babies, 55(65.5%) were born to primi mother and remaining 29(34.5%) were born to multi gavida mother.

Table 17: Distribution according to maternal BMI.

BMI	Underweight <19.9	Normal 20-24.9	Overweight 25-29.9	Obesity 30-34.9	Morbid obesity >35	Total
No. (%)	15 (17.8%)	48 (57.2%)	17 (20.2%)	2 (2.4%)	2 (2.4%)	84 (100%)

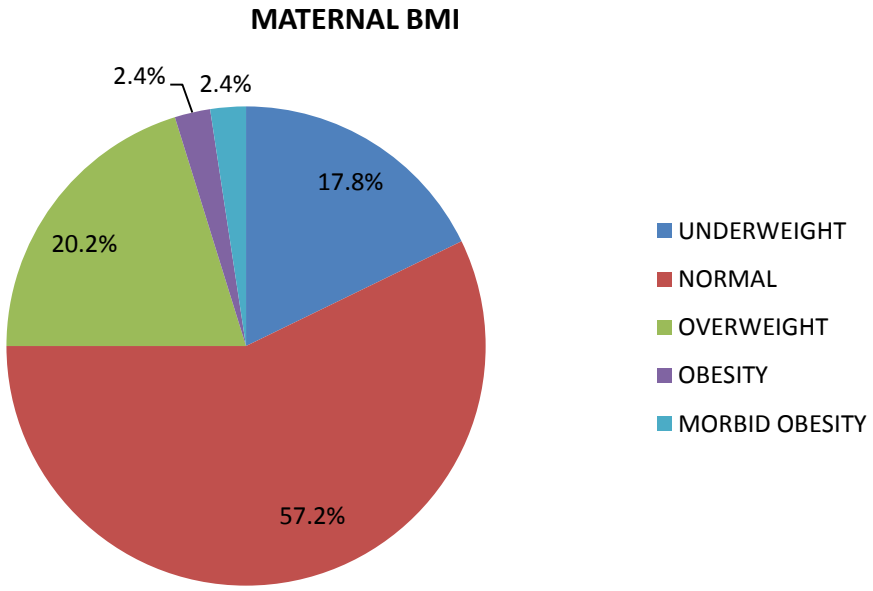

Fig. 21: Distribution according to maternal BMI.

Out of newborn babies 48 (57.2%) were only born to mother with normal BMI and remaining 15 (17.8%), 17 (20.2%), 2 (2.4%) and 2 (2.4%) were born to low BMI, Overweight, obesity and morbid obese mother during 1st trimester.

Table 18: Distribution according to maternal anemia status

Anemia Status	Anemia	No Anemia	Total
No. (%)	70 (83.3%)	14 (16.6%)	84 (100%)

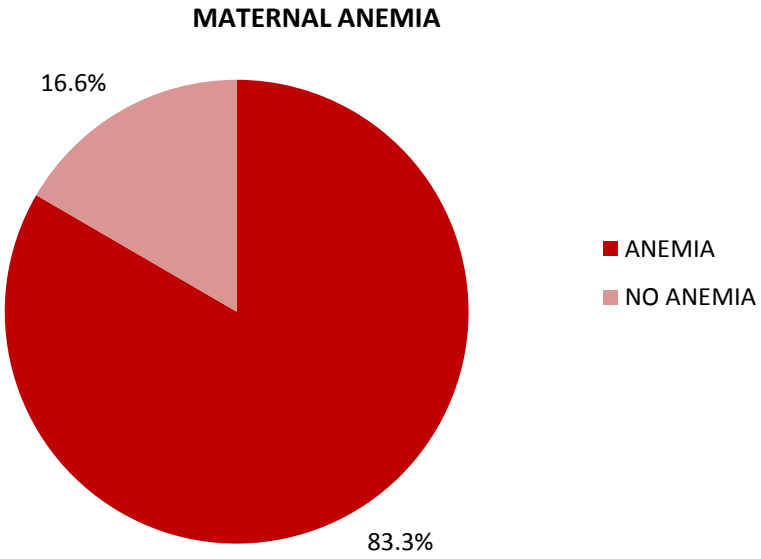

Fig. 22: Distribution according to maternal anemia status

Out of 84 newborn babies, 70 (83.3%) were born to anemic mother and remaining 14 (16.6%) were born to non-anemic mother.

Table 19: Distribution according to maternal medical condition (excluding anemia)

Other medical condition excluding anemia	No. (%)
No other medical condition	66 (78.6%)
Hypothoridism	6 (7.1%)
Pregnancy induced hypertension	2 (2.4%)
Gestational Diabetes Mellitus	2 (2.4%)
Bronchial asthma	6 (7.1%)
Heart disease	1 (1.2%)
SLE	1 (1.2%)
TOTAL	84 (100%)

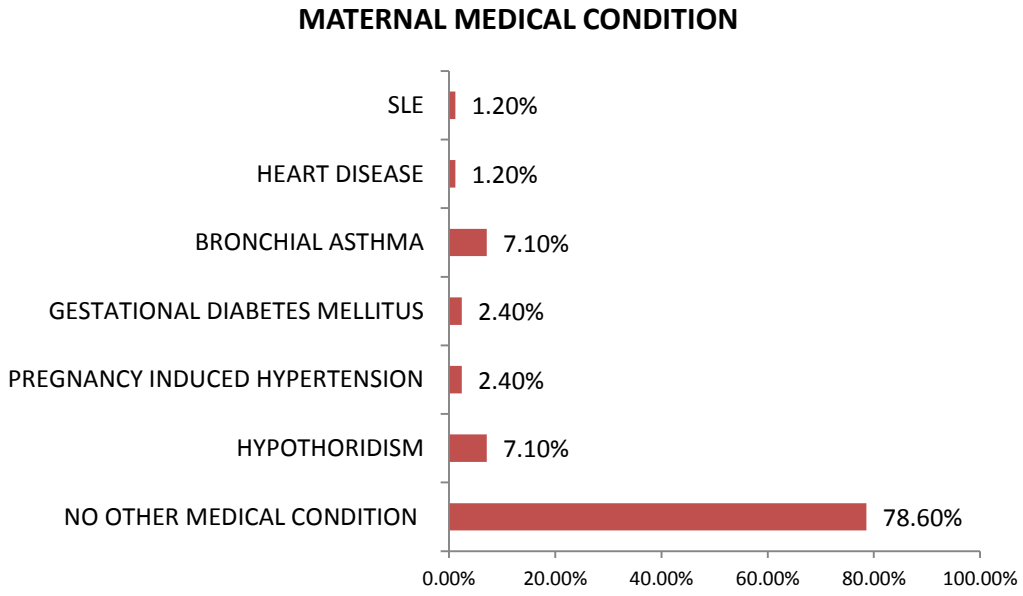

Fig. 23: Distribution according to maternal medical condition (excluding anemia)

Out 84 newborn babies, only 66(78.6%) babies were born to mother with no co morbid medical condition excluding anemia, remaining had hypothyroidism, bronchial asthma, PIH, GDM, Heart disease, SLE with distribution of 7.1%, 7.1%, 2.4%, 2.4%, 1.2% and 1.2% respectively.

D. ASSOCIATION OF FETAL MALNUTRITION WITH FETAL PARAMETERS.

Table 20: Association between sex and fetal malnutrition

	Malnourished CANSCORE <25	Well Nourished CANSCORE >25	Total
SEX	**No. (%)**	**No. (%)**	**No. (%)**
F	25 (64.1%)	14 (35.9%)	39 (46.4%)
M	30 (66.7%)	15 (33.3%)	45 (53.6%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84** (100%)

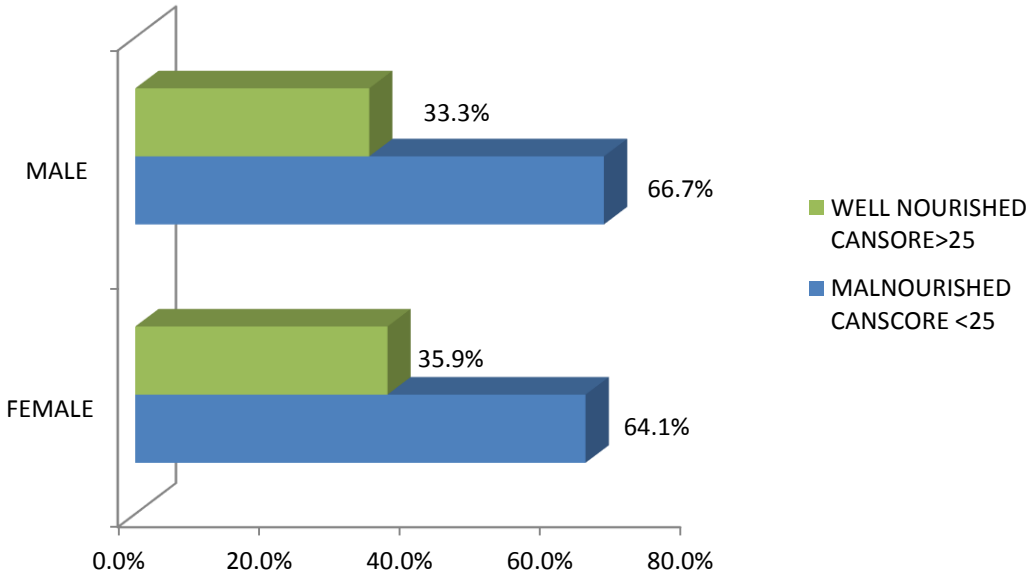

Fig. 24: Association between sex and fetal malnutrition

Out of 39(46.4%) female babies only 14(35.9%) were well nourished reaming 25 (64.1%) were malnourished and there no much difference found between either sex.

Table 21: Association between gestational age and fetal malnutrition

Gestational Age	Malnourished	Well Nourished	Total
Term	48(64.9%)	26 (10.1%)	74 (88.1%)
Late preterm	7 (70 %)	3 (30%)	10 (11.9%)
Total	**55 (65.5%)**	**29(34.5%)**	**84 (100%)**
r – 0.245 & p value- 0.024			

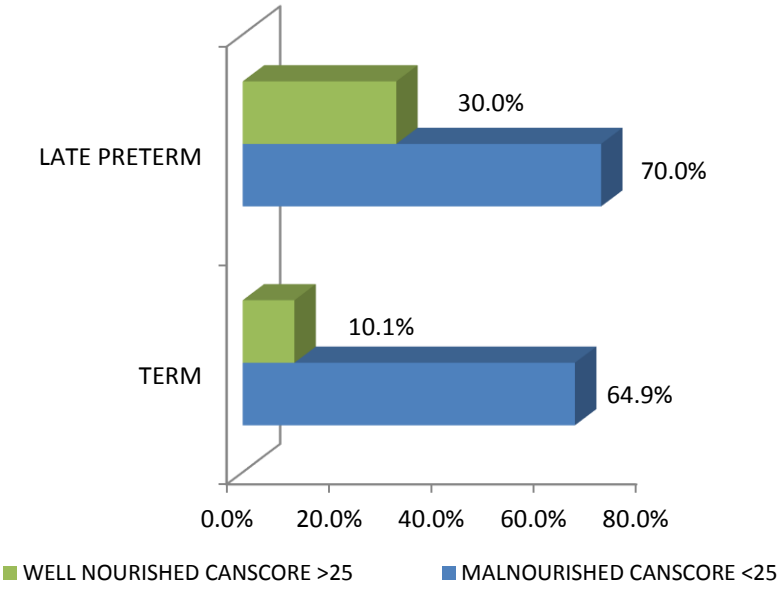

Fig. 25: Association between gestational age and fetal malnutrition

In my study new born babies are broadly classified as term >37 weeks and preterm <36.weeks and 6 days. Preterm is again classified as early and late preterm with cut off gestational age as 34 weeks. Here in my study baby born in early preterm period everyone was noted having fetal malnutrition who were excluded from the study and in late preterm 70% had fetal malnutrition and 65% in term.

Statically gestational age had a moderate positive correlation with CANSORE (r-0.245) which is statistically significant with p value of 0.024 (<0.05)

Table 22: Association between fetal malnutrition by CANSCORE and birth weight for Gestational age

	Malnourished CANSCORE <25	Well Nourished CANSCORE >25	Total
WfGA	**No. (%)**	**No. (%)**	**No. (%)**
AGA	29 (55.8%)	23 (44.2%)	52 (61.9%)
SGA	26 (81.25%)	6 (18.75%)	32 (38.1%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84 (**100%)
P value – 0.017			

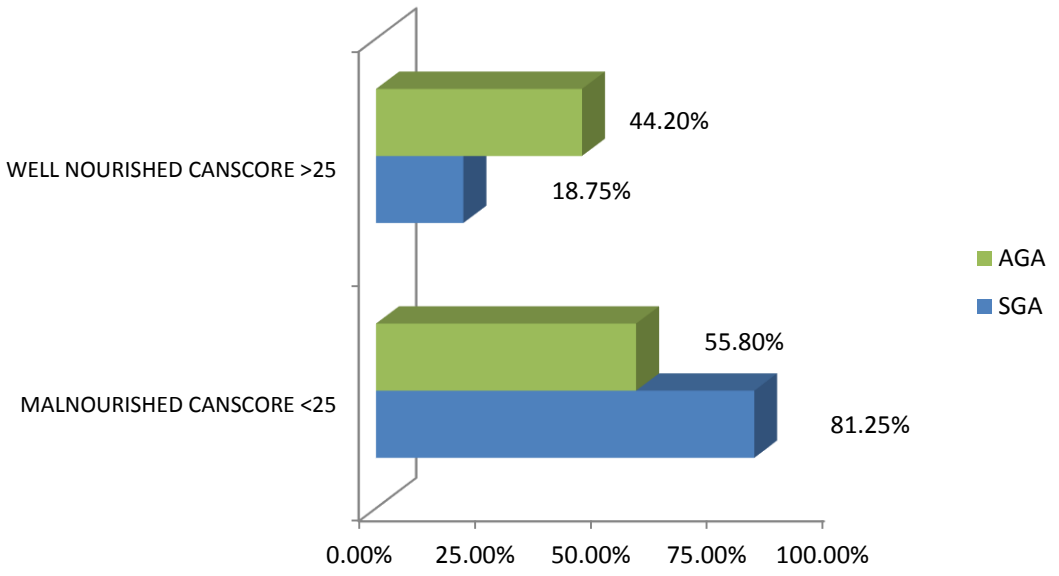

Fig. 26: Association between fetal malnutrition by CANSCORE and birth weight for Gestational age

Out of 84 newborn babies, CANSCORE identified 55 babies as malnourished whereas weight for gestation age identified 32(38.1%) as SGA and 52(61.9%) as AGA with p-value of 0.017which is statistically significant.

Table 23: Association between fetal malnutrition by CANSCORE and babies BMI

	Malnourished CANSCORE <25	Well Nourished CANSCORE >25	Total
BABY BMI	**No. (%)**	**No. (%)**	**No. (%)**
LOW BMI <11.2	41 (74.5%)	14 (25.5%)	55 (65.5%)
NORMAL BMI >11.2	14 (48.3%)	15 (51.7%)	29 (34.5%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84 (**100%)
P value - 0.016			

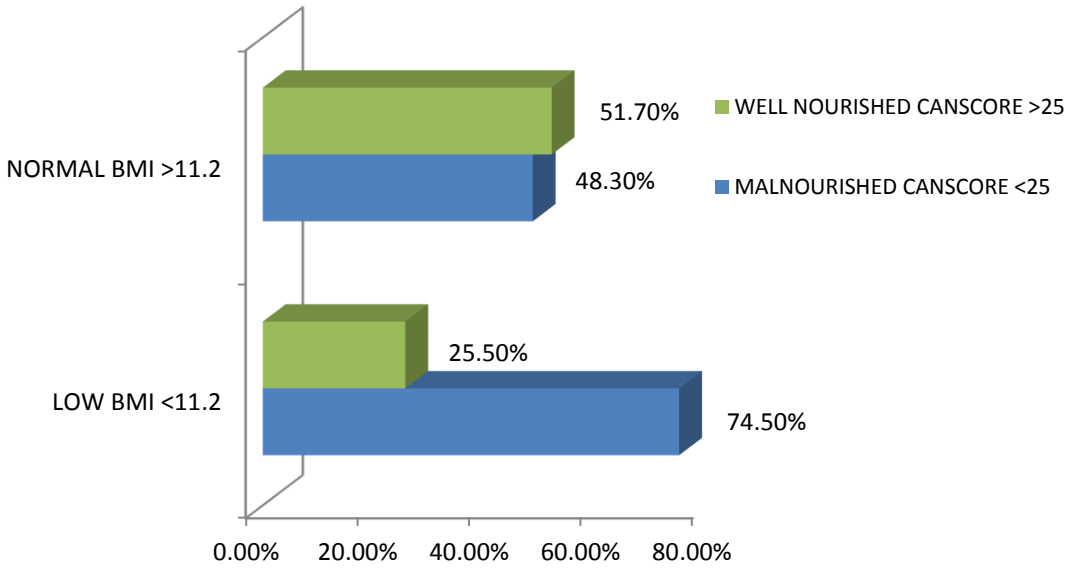

Fig. 27: Association between fetal malnutrition by CANSCORE and babies BMI

Out of 84 babies, 55(65.5%) were malnourished and reaming 29(34.5%) were well nourished based on babies BMI with cut-off as 11.2. By CANSCORE 55(65.5%) were malnourished and 29(34.5%) were well nourished. having CANSCORE as gold standard, out of 55 fetal malnourished malnourished only 41 was detected as malnourished by BMI and out of 29 well-nourished infants 14 were diagnosed as malnourished. And the association is statistically significant with p-value of 0.016 (<0.05).

Table 24: Association between fetal malnutrition by CANSCORE and Ponderal index

	MALNOURISHED CANSCORE <25	WELL NOURISHED CANSCORE >25	Total
Ponderal Index	**No. (%)**	**No. (%)**	**No. (%)**
PI <2.2	39 (76.5%)	12 (23.5%)	51 (60.7%)
PI >2.2	16 (48.5%)	17 (51.5%)	33 (39.3%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84 (**100%)
P value – 0.008			

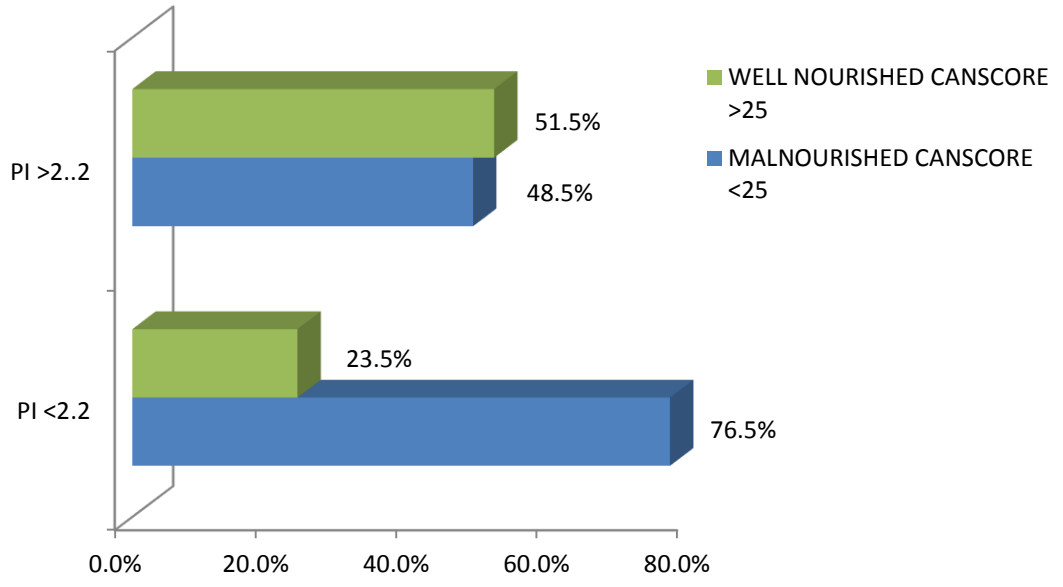

Fig. 28: Association between fetal malnutrition by CANSCORE and Ponderal index

Out of 84 newborn babies, CANSCORE identified 55 babies as malnourished whereas PI identified 51(60.7%) ass malnourished. with p-value of 0.008 (<0.05) were the association is statistically significant.

Table 25: Comparison of CANSCORE with other method for detection of fetal malnutrition

CANSCORE	SENSTIVITY	SPECIFICITY	PPV	NPV
WfGA	74.5%	51.7%	74.5%	51.7%
BMI	52.7%	20.7%	55.7%	18.7%
PI	70.9%	58.6%	76.4%	51.5%

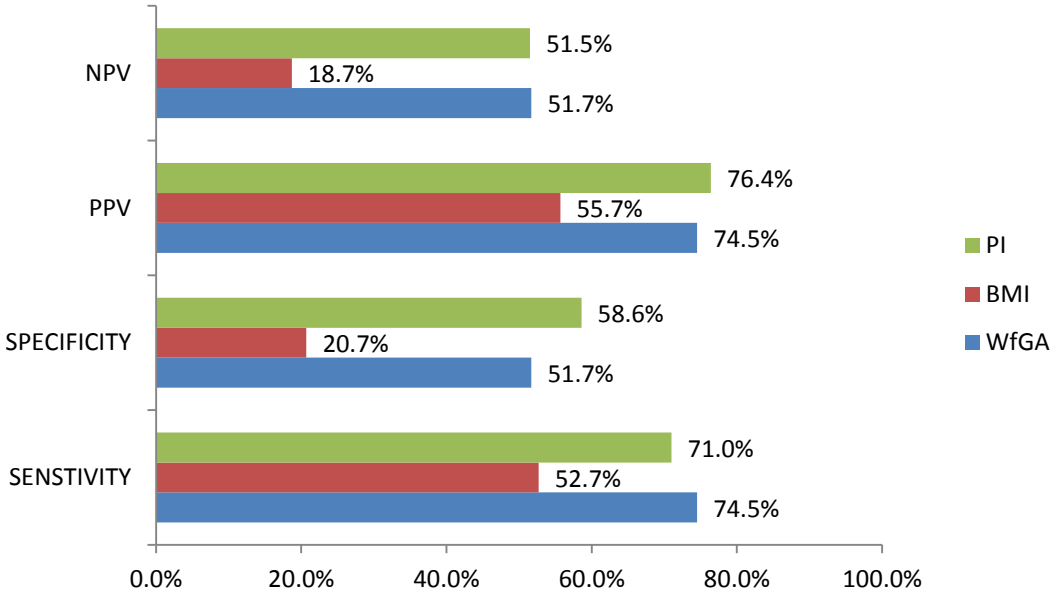

Fig. 29: Comparison of CANSCORE with other method for detection of fetal malnutrition

Having CANSCORE as gold standard in detection of fetal malnutrition, Ponderal index, BMI and birth weight for gestation age is compared. Were out of 55 malnourished infants Ponderal index had identified only 39(76.5%) with sensitivity of 70.9% and specificity 58.6% were birth weight for gestational age has identified only 26 (52.7%) with sensitivity of 74.5% and specificity of 51.7% and BMI has identified 41(74.5%) as malnourished with sensitivity as 52.7% and specificity as 20.7%.

E. ASSOCIATION OF FETAL MALNUTRITION WITH MATERNAL PARAMETERS.

Table 26: Association between maternal-age and fetal malnutrition.

	Malnourished CANSCORE <25	Well nourished CANSCORE >25	Total
AGE	**No. (%)**	**No. (%)**	**No. (%)**
<20 YEARS	24 (68.5%)	11 (31.5%)	35 (41.7%)
>20 YEARS	31 (63.3%)	18 (36.7%)	49 (58.3%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84 (**100%)

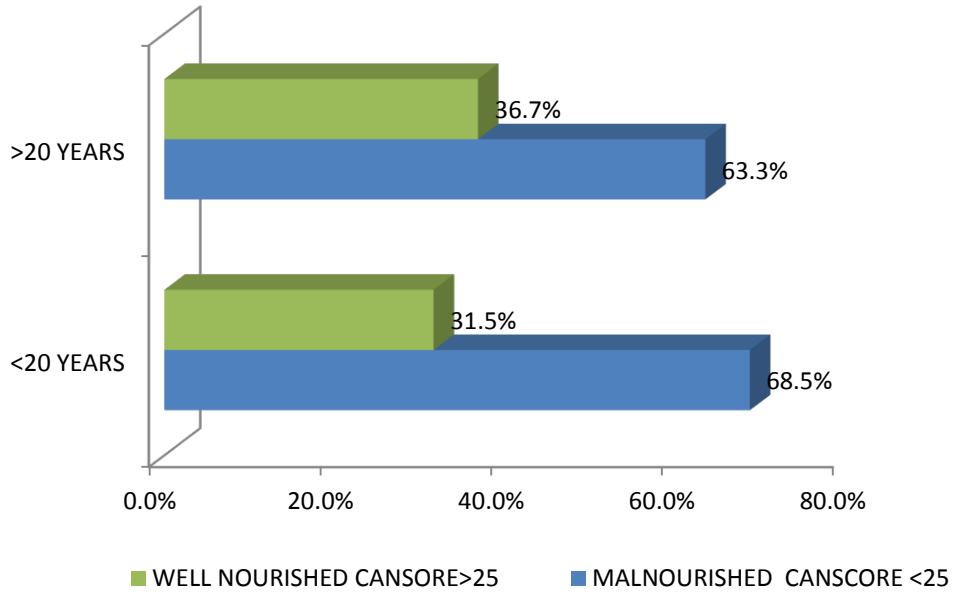

Fig. 30: Association between maternal-age and fetal malnutrition.

Out of total 84 newborn 65.5% were malnourished, on looking the association with maternal age there is no significant difference. That is baby born to mother of age below 20 years 68.5 % were malnourished and in age above 20 years 63.3% were malnourished. P-value is also not scientifically significant.

Table 27: Association between maternal-parity and fetal malnutrition.

	Malnourished CANSCORE <25	Well Nourished CANSCORE >25	Total
GRAVIDAE	**No. (%)**	**No. (%)**	**No. (%)**
PRIMIGRAVIDAE	39 (70.9%)	16 (29.1%)	55 (65.5 %)
MULTIGRAVIDAE	16 (55.2%)	13 (44.8%)	29 (34.5%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84 (**100%)

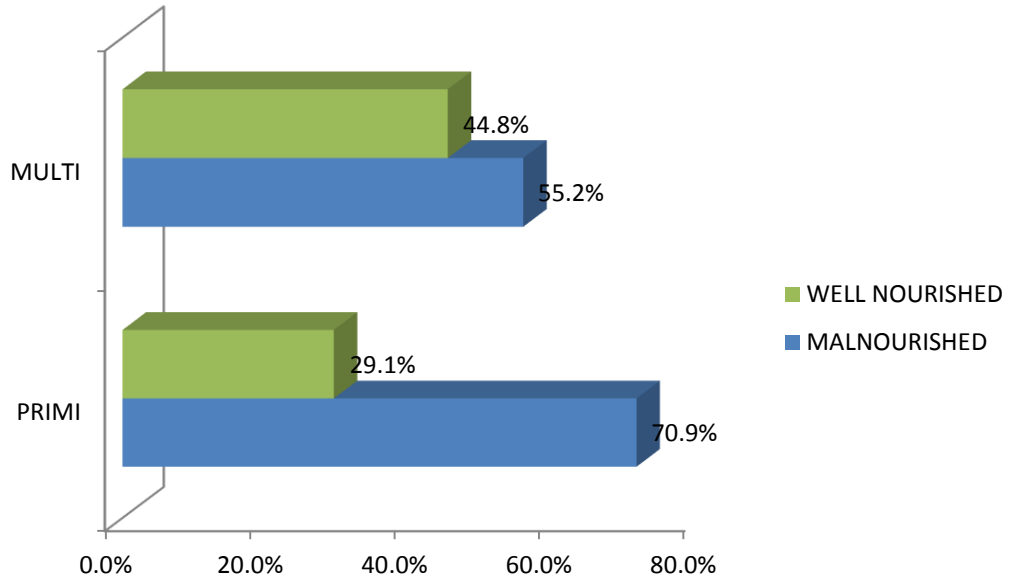

Fig. 31: Association between maternal-parity and fetal malnutrition.

Out of 84 new born babies, 55 (65.5%) were born to primi mother and 39(70.9) were malnourished and only 16(29.1) were well nourished and reaming 29 (34.5%) babies are born to multi paritygravidae mother in which only 13(44.8 %) were well nourished reaming were malnourished. On comparing malnutrition is more seen in primi mother but it is not statically significant.

Table 28: Association between maternal-BMI and fetal malnutrition

	Malnourished CANSCORE <25	Well Nourished CANSCORE >25	Total
Maternal BMI	**No. (%)**	**No. (%)**	**No. (%)**
LOW BMI (<19.9)	11 (73%)	4 (27%)	15 (17.8%)
NORMAL (20-24.9)	27 (56%)	21 (44%)	48 (57.2%)
OVERWEIGHT (25-29.9)	14 (82%)	3 (18%)	17 (20.2%)
OBESITY (30-34.9)	1 (50%)	1 (50%)	2 (2.4%)
MORBID OBESITY (>35)	2 (100%)		2 (2.4%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84 (**100%)

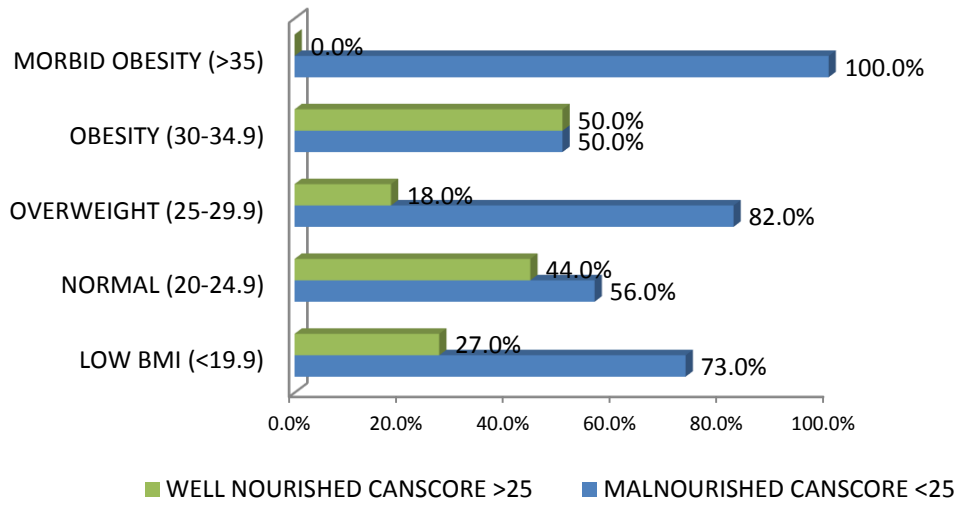

Fig. 32: Association between maternal-BMI and fetal malnutrition

Out of total 84 newborn babies, 15 (17.8%), 48 (57.2%), 17 (20.2%), 2 (2.4%), 2 (2.4%) were born to low BMI mother, normal BMI mother, overweight, obese and morbid obese mothers respectively. Out of 15(17.8%) low BMI mother 11(73%) were malnourished and 4(27%) were well nourished, normal BMI population 27(56%) were malnourished and 21(44%) were well nourished and overweight population 14(82%) were malnourished and 3(18%) were well nourished.

Table 29: Association between maternal-Haemoglobin status and fetal malnutrition

	Malnourished CANSCORE <25	Well nourished CANSCORE >25	Total
ANEMIC STATUS	**No. (%)**	**No. (%)**	**No. (%)**
ANEMIC	48 (68.6%)	22 (31.4%)	70 (83.3%)
NON ANEMIC	7 (50%)	7 (50%)	14 (16.6%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84 (**100%)

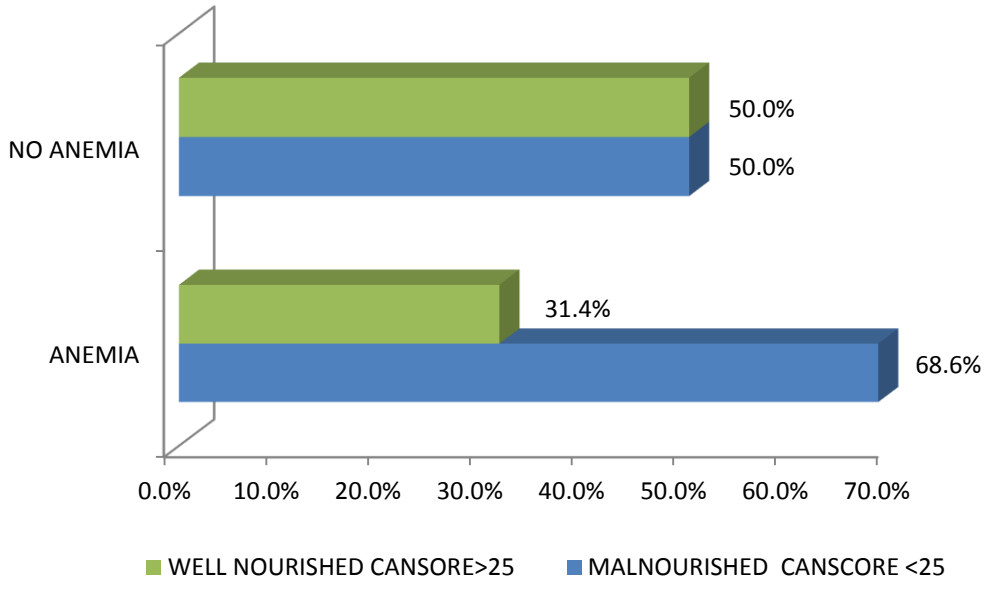

Fig. 33: Association between maternal-Haemoglobin status and fetal malnutrition

Out of total 84 newborn babies 70 were born to anemic mother and reaming 16 was born to non-anemic mother. It was noted malnutrition was more common in babies born to anemic mother i.e. in anemic population 48 (64.6%) were malnourished, only 22 (31.4%) is well nourished and in non anaemic population 7(50%) were malnourished. But this association is not statically significant.

Table 30: Association between maternal-medical condition and fetal malnutrition

	Malnourished CANSCORE <25	**Well Nourished CANSCORE >25**	**Total**
Other Maternal Medical Conditions	**No. (%)**	**No. (%)**	**No. (%)**
No medicalcondition excluding anemia	45 (81.8%)	21 (72.4%)	66 (78.6%)
Hypothyrodism	3 (5.5%)	3 (10.4%)	6 (7.1%)
Pregnancy induced hypertension	2 (3.6%)	0	2 (2.4%)
Gsetational diabetes mellitus	1 (1.8%)	1 (3.4%)	2 (2.4%)
Bronchial asthma	3 (5.5%)	3 (10.4%)	6 (7.1%)
Heart disease	1 (1.8%)	0	1 (1.2%)
SLE	0	1 (3.4%)	1 (1.2%)
Total	**55** (65.5 %)	**29** (34.5 %)	**84** (100%)

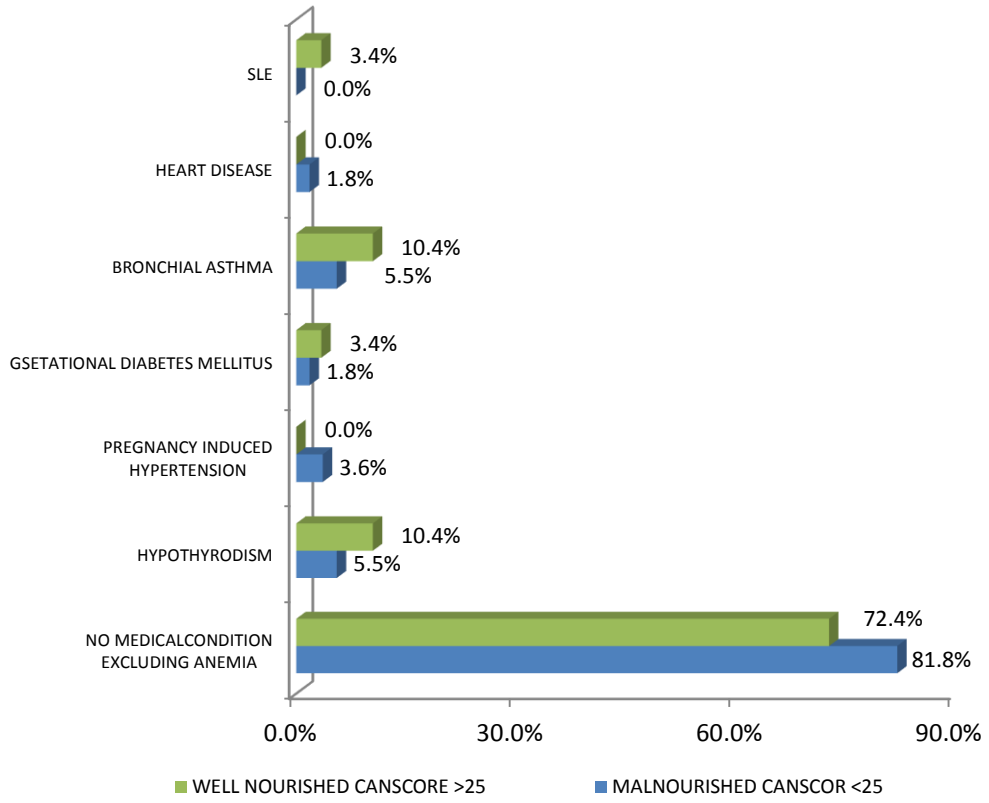

Fig. 34: Association between maternal-medical condition and fetal malnutrition

As said early incidence of hypothyroidism, PIH, GDM, BA, heart disease and SLE is 6 (7.1%),2 (2.4%), 2 (2.4%), 6 (7.1%), 1 (1.2%), 1 (1.2%)respectively and there is no significant association noted between the disease and normal population.

DISCUSSION

Assessment of fetal nutrition status at birth is more important because of its effect on all major organs with its immediate and long term sequelae which even includes neonatal mortality. The clinical feature of the FM depends on the time of insult and duration of insult in fetus. When the fetus is exposed to malnutrition during early fetal period they are more likely to have symmetric growth retardation i.e. weight, length and head circumference are equally affected. And when the fetus is exposed to malnutrition during the late pregnancy then weight is more affected then height and head circumference. There are various method used for assessment of fetal malnutrition which includes anthropometric measurements and CANSCORE.

A. DESCRIPTION STATISTICS OF ANTHROPOMETRIC VARIABLE.

Mean birth weight of 84 babies in our study, irrespective of the gestational is 2383grams ± 205 gram, length 47.67 cm ± 6.53 and head circumference is 31.52 cm ± 1.76. on comparing with the other study as mentioned in Table:31 were the highest mean weight and length are noted in study conducted by Sahin Hamilcikan et al. (2017), as 3645 ± 396.9 and 49.38 ± 2.2 respectively.

Table 31: Comparison of birth weight and length of the present study with other studies

Studies	Sample size	Birth weight (gms)	Birth length (cms)
Metcoff J[5] (1994)	1382	3290 ± 390	-
Mehta et al.[41] (1998)	637	2600 ± 480	48.01 ± 2.36
Rao et al.[42] (1999)	372	2762 ± 505.2	46.2 ± 2.86
Liladhar et al.[48] (2006)	500	2788 ± 440	48.12 ± 1.92
Korkmaz A et al.[56] (2011)	93	1819 ± 355	43.2 ± 2.9
B N Ezenwa et al.[59] (2013)	140	2100 ± 600	43.2 ± 5
Abhaykumar Dhanorkar et al.[61] (2014)	384	2657 ±392	48.8 ± 1.83
Faheem M et al.[64] (2014)	400	2911.94 ±433.88	48.16 ±2.46
Almarzoki J M.[65] (2014)	203	2910 ± 580	
B N Ezenwa et al.[67] (2016)	282	3260 ± 460	49.37 ± 2.26
Sahin Hamilcikan et al.[124] (2017)	241	3645 ± 396.9	49.38 ± 2.2
My study	84	2383±205	47.67± 6.533

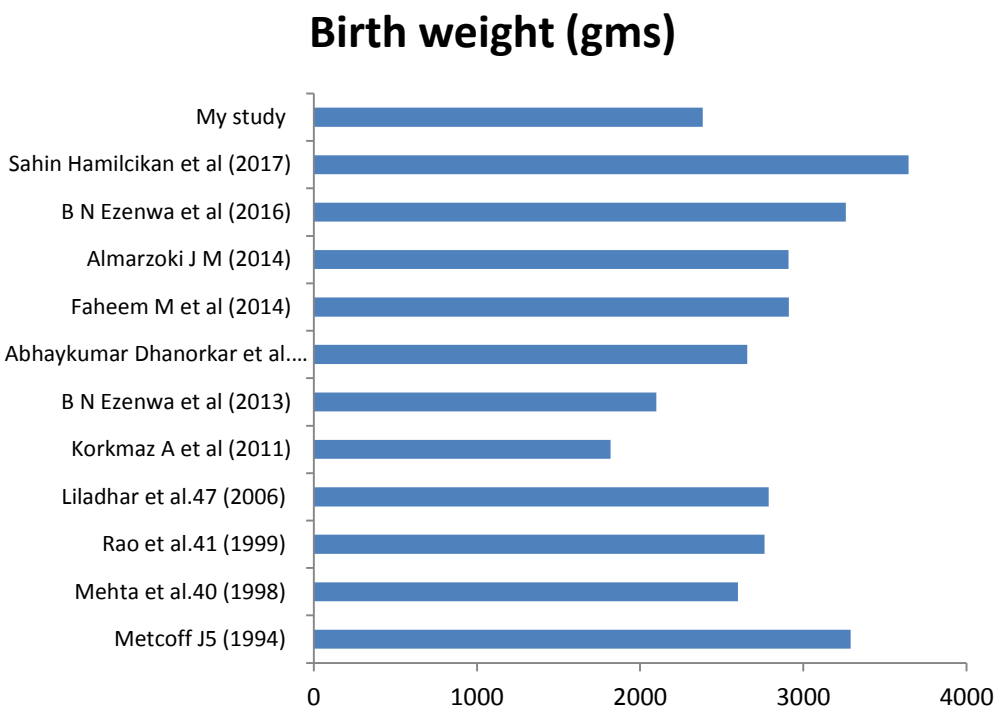

Fig. 35: Comparison of birth weight of the present study with other studies

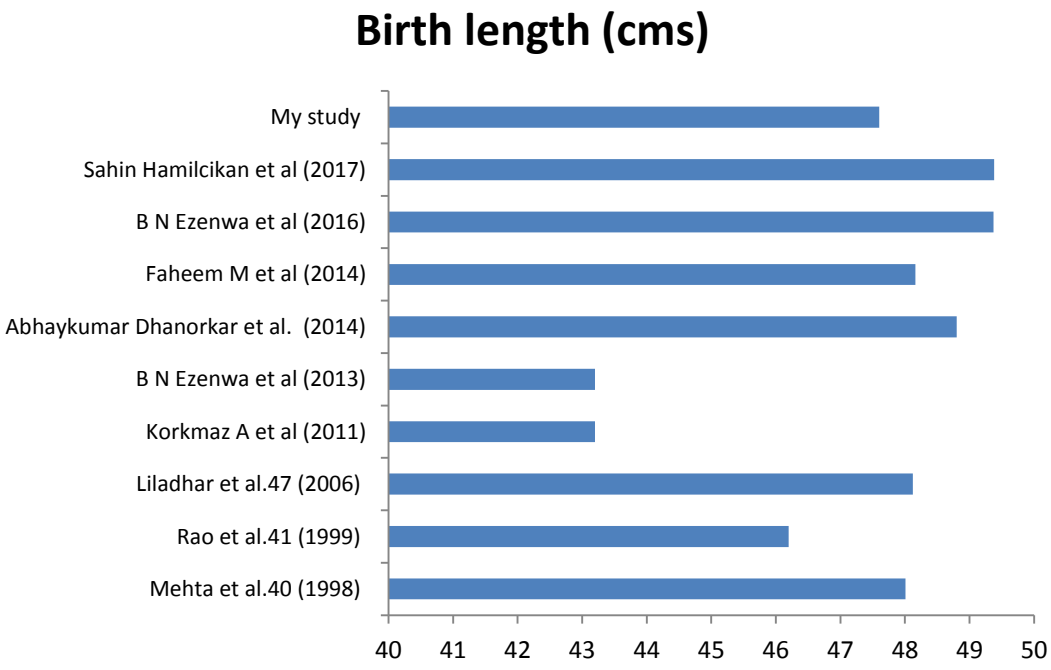

Fig. 36: Comparison of birth length of the present study with other studies

B. DISTRIBUTION ACCORDING TO NEWBORN PARAMETERS

Table 32: comparison of fetal malnutrition in different studies based on CAN score scoring system

Studies	Total number	Malnourished	Percentage
Metcoff J.[5] (1994)	1382	151	10.9
Mehta et al.[41] (1998)	637	255	40.03
Rao et al.[42] (1999)	372	104	27.45
Liladhar et al. [48] (2006)	500	137	27.4
Adebamit et al.[51] (2008)	442	83	18.8
Grish Nanoti. [125](2013)	60	7	11.6
Korkmaz A et al.[56] (2011)	93	50	54.58
B N Ezenwa et al.[59] (2013)	140	19	28.4
Abhaykumar Dhanorkar et al.[61] (2014)	384	124	32.29
Faheem M et al.[64] (2014)	400	98	24.5
Almarzoki J M.[65] (2014)	203	63	31
B N Ezenwa et al.[67] (2016)	282	41	14.5
My study	84	55	65.5

In my current study, we had total of 84 newborn in which 88.1% were term and 11.9 % were born preterm. On comparing my study with other study, incidence of fetal malnutrition by CANSCORE varies from 10.9% to 54.58% but in my study incidence of fetal malnutrition is 65.5% which is significantly higher than other studies as charted.

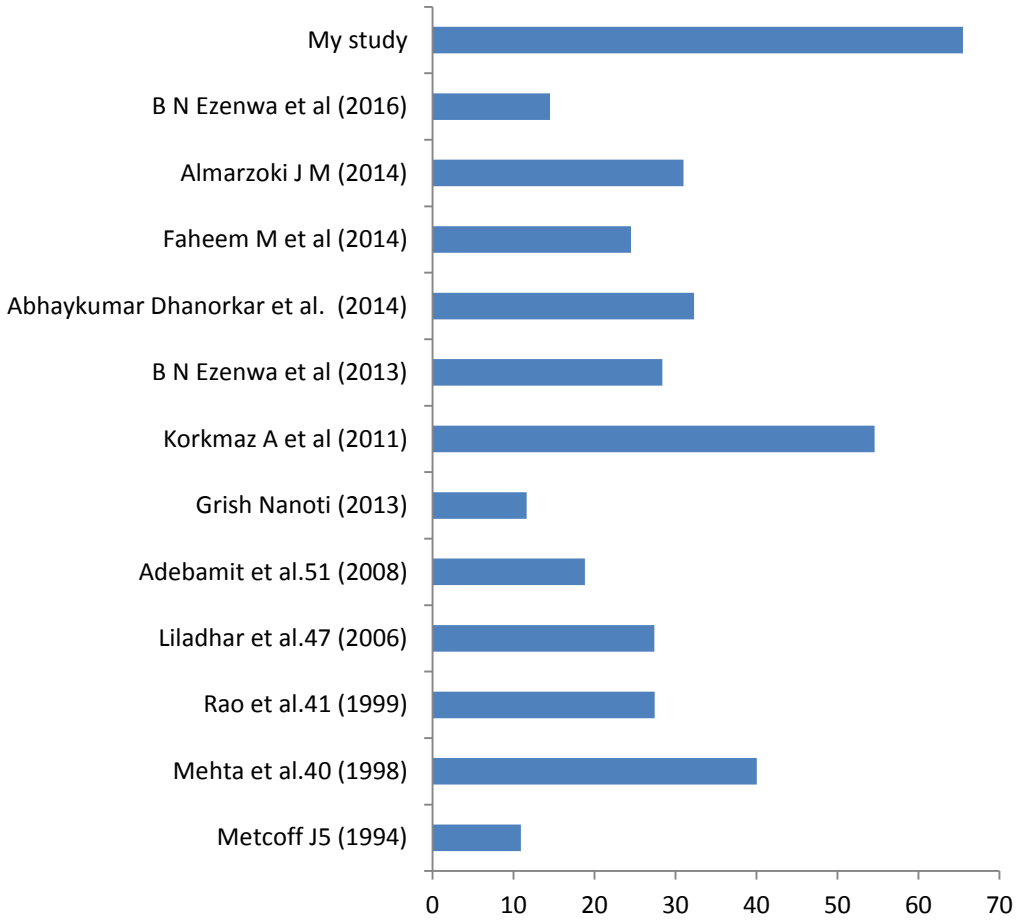

Fig. 37: Comparison of fetal malnutrition in different studies based on CAN score scoring system

Table 33: Comparison of weight for gestational age of the present study with other studies

Studies	Sample	AGA babies	SGA babies
Metcoff J[5] (1994)	1382	1229 (89%)	153 (11%)
Mehta et al.[41] (1998)	637	478 (75%)	159 (25%)
Rao et al.[42] (1999)	372	217 (58.33%)	155 (41.77%)
Liladhar et al.[48] (2006)	500	313 (62.6%)	187 (37.4%)
Korkmaz A et al[56] (2011)	93	75(80.65%)	18 (19.35%)
Vikram singh et al.[58] (2012)	200	75(37.5%)	125 (62.5%)
B N Ezenwa et al.[59] (2013)	140	135 (96.4%)	5 (3.6%)
Faheem M et al.[64] (2014)	400	368 (92%)	32(8%)
B N Ezenwa et al.[67](2016)	282	2764 (97.2%)	8 (2.8%)
My study	84	52 (61.9%)	32 (38.1%)

In others study, it is noted that incidence of SGA varies from 2.8% to 62.5% and in my study incidence is 38.1% remaining 61.9% of the babies were in AGA group as described in table-

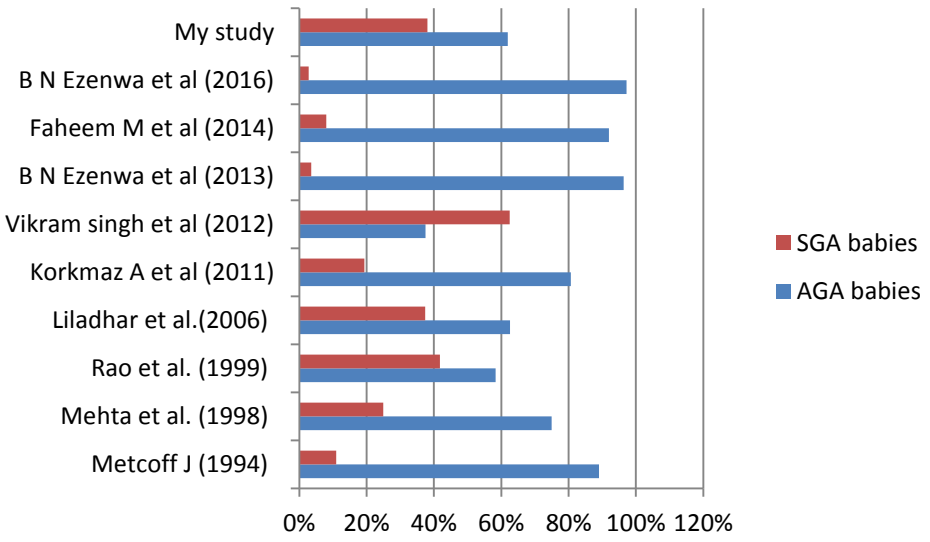

Fig. 38: Comparison of weight for gestational age of the present study with other studies

C. ASSOCIATION OF FETAL MALNUTRITOIN WITH NEONATAL PARAMETERS

In the current study, we are using CANSCORE as the gold standard for detecting the nutritional status of newborn at birth, association of fetal malnutrition with neonatal parameters and other commonly used anthropometric indices are discussed below.

On comparing the fetal malnutrition with the sex of the baby there is no significant association i.e. 65.5% had fetal malnutrition and among male it is 66.7% and female 64.1%. On comparing the fetal malnutrition with the gestation age, it was found that in newborn babies <34 weeks CANSCORE is not applicable, as all babies had evidence of fetal malnutrition because of poor development of subcutaneous fat tissues. Hence CANSCORE can be used in preterm above >34 weeks of a gestation and in term neonates and gestational age had a moderately positive correlation with CANSCORE (r- 0.245) which is statistically significant (p value 0.024)

BN Ezenwa et al (2013), in his study on preterm babies of gestation age 28 weeks to 36 weeks, were he concluded CANSCORE is even applicable in preterm babies, but AS Ali et al (2016)[63] concluded in his study that though CANSCORE is good screening tool for identification of fetal malnutrition, for better accuracy there should be some adjustment in variable and scoring.

Table 34: Comparison of Relation of fetal malnutrition in AGA and SGA babies based on CANSCORE in various studies

	AGA babies		SGA babies	
Studies	**No. of babies**	**Malnourished**	**No. of babies**	**Malnourished**
Metcoff J (1994)[5]	1229 (89%)	**68 (5.53%)**	153 (11%)	**83 (54.2%)**
Rao et al. (1999)[42]	217 (58.30%)	**26 (11.98%)**	155(41.7%)	**78 (50.32%)**
Liladhar et al. (2006)[48]	313 (62.60%)	**25 (8.30%)**	187(37.4%)	**112 (59.89%)**
Vikram singh et al.[58] (2012)	75 (37.50%)	**6 (8%)**	125 (62.50%)	**29 (23.20%)**
B N Ezenwa et al.[59] (2013)	135 (96.40%)	**43 (31.80%)**	5 (3.60%)	**5 (100%)**
Faheem M et al.[64] (2014)	368 (92%)	**68(18.50%)**	32(8%)	**30(93.80%)**
My study	52 (61.90%)	**29 (55.80%)**	32 (38.10%)	**26 (81.25%)**

As discussed early fetal malnutrition is found even in AGA babies, this is the comparison showing incidence of fetal malnutrition in SGA & AGA babies. In our study it was found 55.8% AGA babies and 81.25% SGA were with fetal malnutrition, which is high on comparing this data with other studies incidence of FM in AGA varies from 5.53% to 31.8% and in SGA from 23.2% to 100%

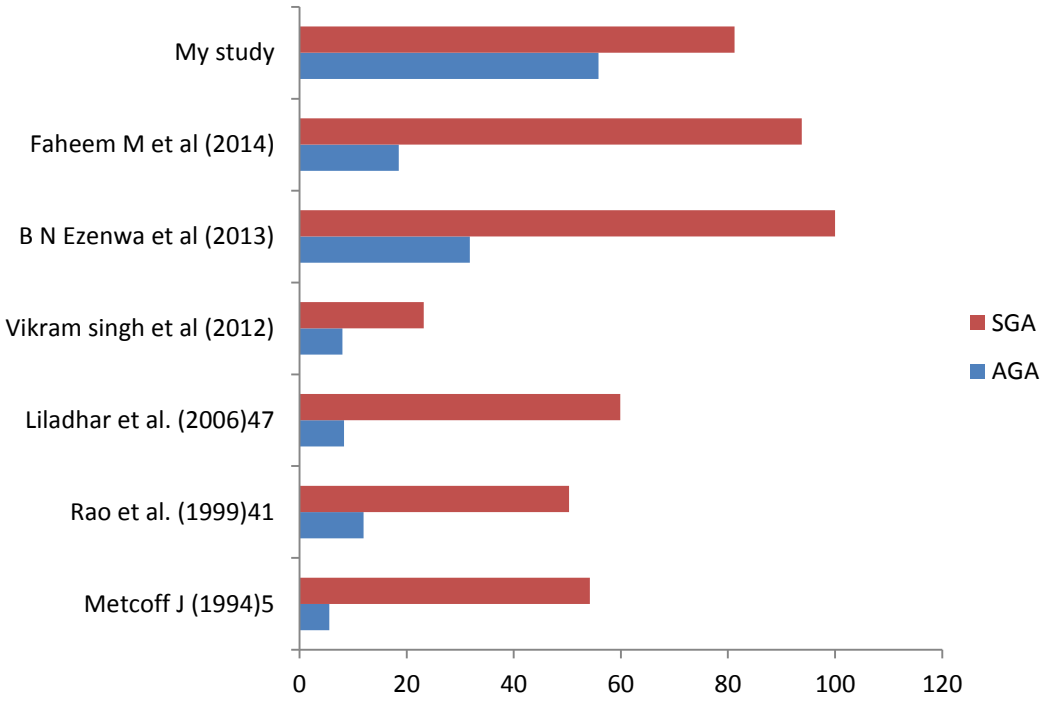

Fig. 39: Comparison of Relation of fetal malnutrition in AGA and SGA babies based on CANSCORE in various studies

Table 35: Comparison of Sensitivity and specificity of weight for gestational age with CANSCORE as gold standard.

Studies	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Vikram singh et al.[58] (2012)	80.85%	41.81%	23.20%	92%
B N Ezenwa et al.[59] (2013)	10.40%	100%	100%	68.10%
Abhaykumar Dhanorkar et al.[61] (2014)	85%	97%	93%	93%
Faheem M et al.[64] (2014)	30.60%	99%	93.70%	81.50%
B N Ezenwa et al.[67] (2016)	2.40%	97.10%	12.50%	85.40%
My study	74.50%	51.70%	74.50%	51.70%

In my study sensitivity of weight for gestational age is 74.5% and specificity is 51.7% on comparing with other studies observed highest sensitivity is 80.85% by study conducted by Vikram Singh et al (2012) and highest specificity observed is 99% by Faheem M et al (2014).

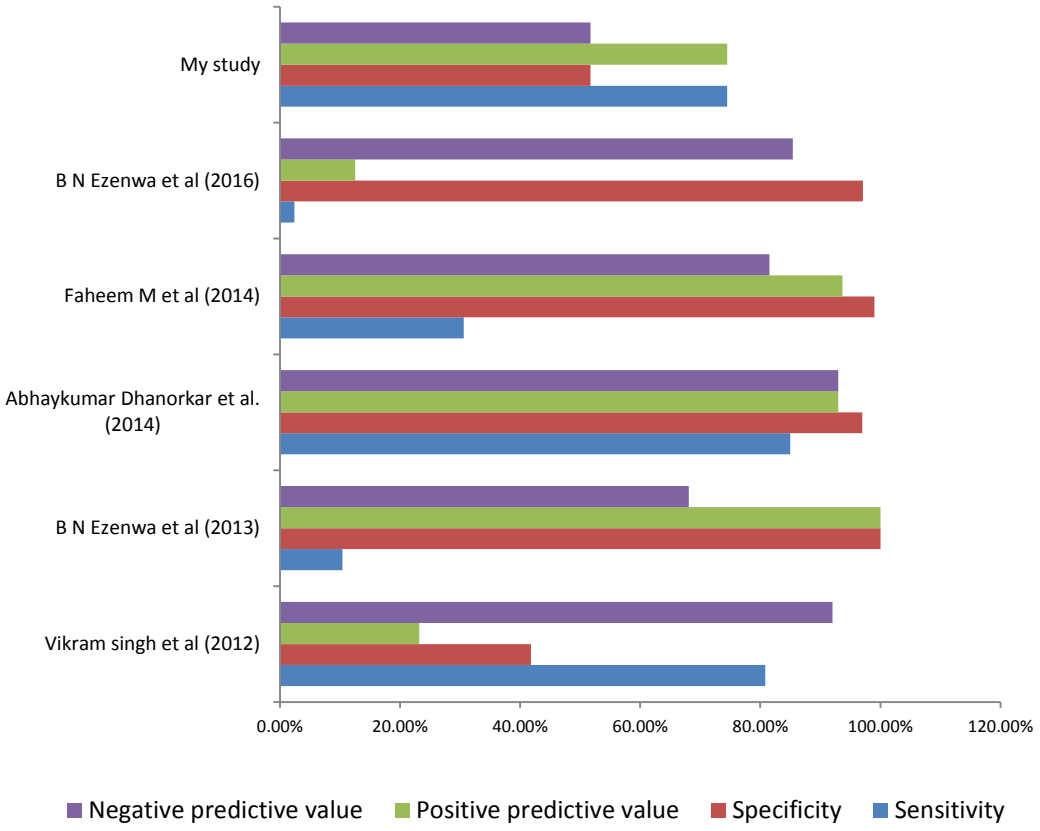

Fig. 40: Comparison of Sensitivity and specificity of weight for gestational age with CANSCORE as gold standard.

Table 36: Comparison of CAN score and Ponderal index with other studies

Studies	CAN score (<25)	Ponderal index (<2.25)
Mehta et al.[5] (1998)	40%	29.19%
Liladhar et al.[48] (2006)	27.40%	27.80%
B N Ezenwa et al.[59] (2013)	34.30%	30.70%
Abhaykumar Dhanorkar et al.[61] (2014)	32.90%	24.48%
Faheem M et al.[64] (2014)	24.50%	5.75%
Almarzoki J M.[65] (2015)	17.50%	21.20%
B N Ezenwa et al.[67] (2016)	14.50%	10.30%
Sahin Hamilcikan et al.[124] (2017)	71.23%	78%
Vikram singh et al.[58](2012)	17.50%	8%
My study	65.50%	60.70%

On comparing CANSCORE with PI, CANSCORE detects more no of fetal malnutrition than Ponderal Index and in my study 65.5% fetal malnutrition was detected by CANSCORE and 60.7% by PI were results almost similar in most of the studies except in study conducted by Almarzoki J M et al. (2015) & Liladhar et al. (2006), were PI detected more than CANSCORE as tabulated.

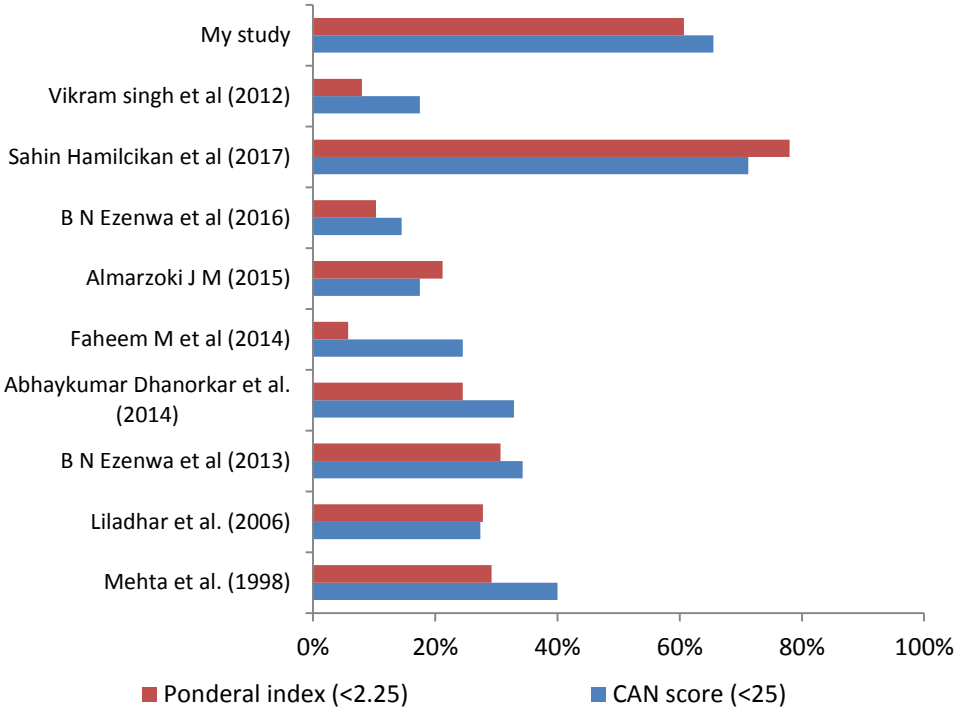

Fig. 41: Comparison of CAN score and Ponderal index with other studies

Table 37: Comparison of fetal malnutrition based on Ponderal index with other studies.

Studies	Total number	Malnourished
Mehta et al.[41] (1998)	637	186 (29.19%)
Liladhar et al.[48] (1999)	500	139 (27.8%)
B N Ezenwa et al.[59] (2013)	140	43 (30.7%)
Abhaykumar Dhanorkar et al.[61] (2014)	384	93 (24.48%)
Faheem M et al.[64] (2014)	400	23(57.5%)
Almarzoki J M.[65] (2015)	203	43(21.2%)
B N Ezenwa et al.[67] (2016)	282	29(10.3%)
Sahin Hamilcikan et al.[123] (2017)	241	57(78%)
Vikram singh et al.[58] (2012)	200	16(8%)
My study	84	51 (60.7%)

Having ponderal index as a tool for malnutrition babies are classified into two group in which 60.7% were noted to have malnutrition, were on comparing with other studies it was reported, malnutrition rate is as high as 78% by the study conducted by Sahin Hamilcikan et al (2017).

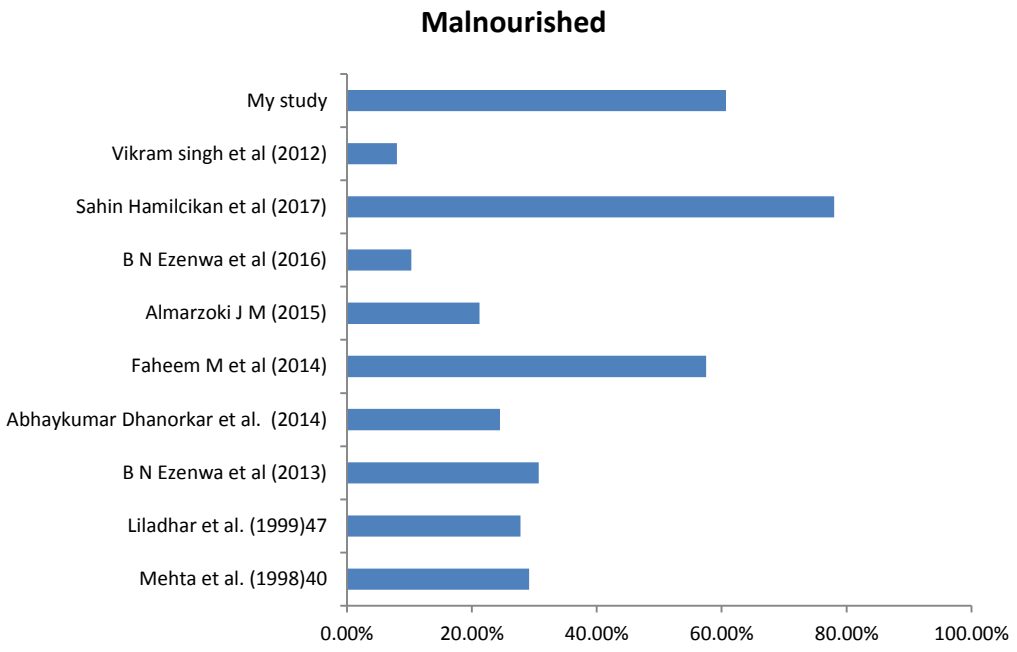

Fig. 42: Comparison of fetal malnutrition based on Ponderal index with other studies.

Table 38: Comparison of Sensitivity and specificity of Ponderal index with CANSCORE as gold standard.

Studies	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Mehta et al.[41] (1998)	65.6%	70.5%	47.8%	83.2%
Liladhar et al.[47] (2006)	70.7%	88.15%	69%	88%
Vikram singh et al.[58] (2012)	28.57%	96.36%	62.5%	86.41%
B N Ezenwa et al.[59] (2013)	29.2%	68.5%	32.6%	64.9%
Dhanorkar AK et al.[61] (2014)	61%	93%	81%	83%
Faheem M et al.[64] (2014)	34.7%	89.4%	51.5%	80.8%
Almarzoki JM[65] (2015)	31.7%	83.6%	46.5%	73..1%
B N Ezenwa et al.[67] (2016)	19.5%	90.9%	24.1%	86.6%
My study	70.9%	58.6%	76.4%	51.5%

Having CANSCORE as gold standard, sensitivity, specificity, PPV and NPV were calculated and these reports is compared with other studies as tabulated. In my study sensitivity of PI is 70.9 which is more on comparing with other studies. Specificity is 58.6% which less on comparing with other studies.

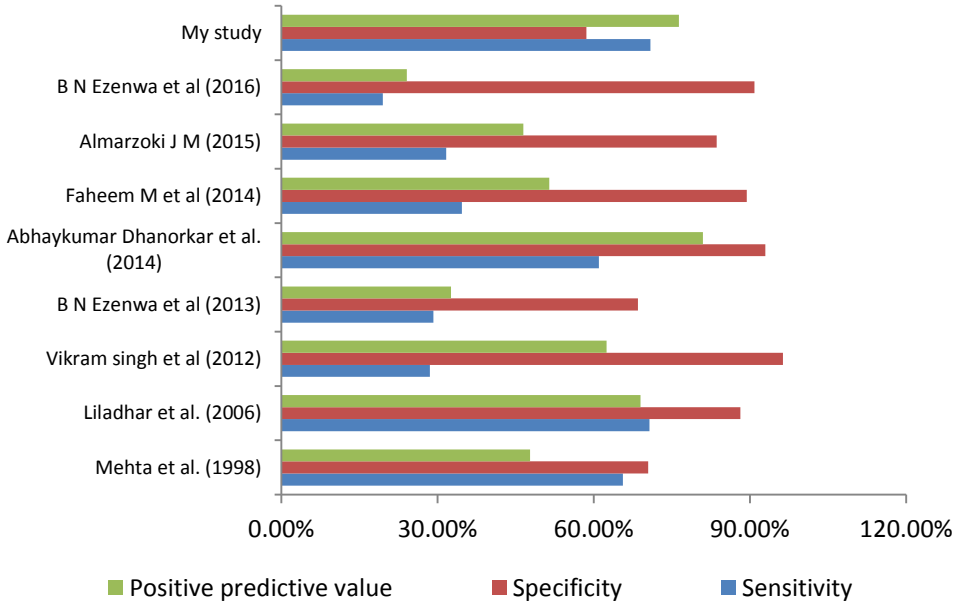

Fig. 43: Comparison of Sensitivity and specificity of Ponderal index with CANSCORE as gold standard.

Table 39: Comparison of Sensitivity and specificity of BMI with CANSCORE as gold standard

Studies	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Almarzoki J M. [65] (2015)	69.8%	72.1%	53.1%	84.2%
BN Ezenwa et al. [67] (2016)	53.7%	93.7%	59.5%	92.2%
My study	52.7%	20.7%	55.7%	18.7%

On comparing my study with all other study it is observed, BMI has poor senstivity and specificity of 52.7% and 20.7 % respectively.

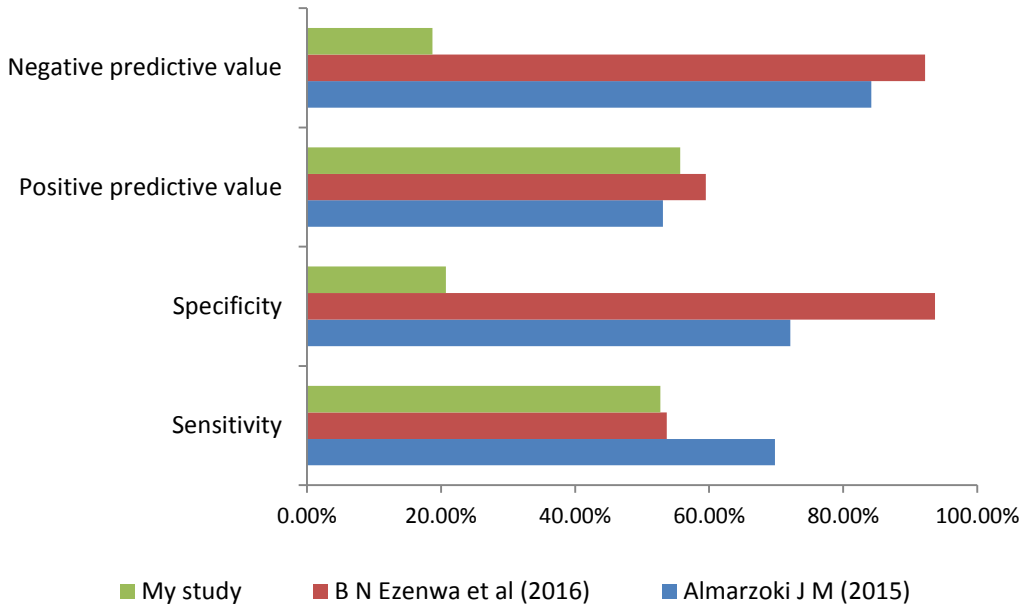

Fig. 44: Comparison of Sensitivity and specificity of BMI with CANSCORE as gold standard.

D. ASSOCIATION OF FETAL MALNUTRITION WITH MATERNAL PARAMETERS

1. In my present study, There is no much difference noted in incidence of fetal malnutrition in according to maternal age i.e. 68.5% in <20 years mother, 63.3% in > 20 years old mother with the average of 65.5% with p value of 0.614 which not statistically significant.

2. It is noted incidence of fetal malnutrition was more in primi gravidae i.e 70.9% of babies born to primi mother had fetal malnutrition were as in multi gravid mother incidence is as less as 55.2 % but the p value is 0.149 which is not statistically significant.

3. It is observed that incidence of fetal malnutrition is more in baby born to mother with low BMI i.e 73.3% were malnourished but fetal malnutrition is reduced to 56.2% in babies born to normal BMI mother. The p value is 0.229 (above 0.05) which is not statistically significant.

4. In the present study there was a significant association noted between fetal malnutrition and maternal anemia i.e. incidence is 68.6 % were as in non-anemia population incidence is reduced to 50%. But statistically there is no much significance (p value-0.182).

5. My present study there is no much significance noted in babies with fetal malnutrition and maternal medical conditions like SLE, heart disease, hypothyroidism, PIH and GDM.

CONCLUSION

Low birth weight is a major public health problem in developing countries like India with high morbidity and mortality. Generally newborn babies are classified as Appropriate for gestational age and small for gestational age in relation to gestational age. However it is known that a birth weight of 2.5kg does not rule out fetal malnutrition which is of clinical importance.

CANSCORE is a simple, bedside systematic method in identifying fetal malnutrition. Being a bed side test, it does not require any specialized equipment, major calculation or laboratory investigation. Assessing fetal malnutrition by CANSCORE is not time consuming can be done with minimal training.

In this study, among 84 newborn of gestation age above 34 weeks, CANSCORE had statistically significant association with birth weight according to gestational age (p value - 0.017), neonatal BMI (p value - 0.016), Ponderal index (p value - 0.008).

Gestational age had moderately positive correlation with CANSCORE(r- 0.245) which is statically significant with p value of 0.024.

CANSCORE showed a Positive predictive value of 74.5%, Negative Predictive value of 51.7%, sensitivity of 74.5% and specificity of 51.7% with weight for gestational age.

CANSCORE had Positive predictive value of 55.7%, Negative Predictive value of 18.7%, sensitivity of 52.7% and specificity of 20.7% with neonatal BMI.

CANSCORE had Positive predictive value of 76.4%, Negative Predictive value of 51.5%, sensitivity of 70.9% and specificity of 58.6% with Ponderal index.

CANSCORE is recommended as a simple, non-expensive bedside tool for assessment for malnutrition among newborn more than 34 weeks of gestation. This is expected to result in early intervention and better outcome.

SUMMARY

This study was undertaken to assess the newborn nutritional status at birth using CANSCORE and to compare it with other commonly used indices and also to compare the maternal nutritional status with and medical condition with fetal malnutrition.

1. We had total of 84 newborn, male to female ratio of 1.15: 1.
2. The mean birth weight was 2380 $\pm$ 205 grams, length 47.67 $\pm$ 2.55 and head circumference was 31.5 $\pm$ 1.31cms.
3. Out of 84, 52 (61.9%) were born AGA and 32 (38.1%) were born SGA.
4. According to CANSCORE, 55(65.5%) had fetal malnutrition and 29 (35.5%) were well nourished with cut off as 25.
5. According to PI, 51 (60.7) were malnourished and 33 (39.3%) were well nourished.
6. According to BMI, 55 (65.5%) were malnourished and 29 (34.5) were well nourished.
7. On comparing with other indices, CANSORE had a moderately positive correlation with gestational age.(r-0.245, p valve -0.024)
8. Having CANSCORE as gold standard, weight for gestation age is more sensitive followed by PI and BMI and PI has highest specificity and Positive predictive value.
9. There was significant relation noted with maternal early pregnancy BMI. Thus the CANSCORE is recommended as a screening tool for identifying fetal malnutrition in all babies above 34 weeks of gestation.

LIMITATIONS

1. Nutritional assessment by CANSCORE, being subjective assessment it is likely to vary from one person to other.
2. It is not found applicable in babies less than 34 weeks of gestation.
3. The sample size was low and the no. of participants in term vs preterm was unequal(74 vs 10)
4. There was no follow up or outcome of the study participants was done, as it was a cross-sectional study.

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APPENDIX

APPENDIX - 1

SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES

KULASEKHARAM

RESEARCH COMMITTEE

CERTIFICATE

This is to certify that The Research Protocol Submitted by Dr. M. THIRUMALAI VASAN

Faculty / Post Graduate from Department of PAEDIATRICS

Titled CAN SCORE IN NEW BORN BABIES AND ITS CORRELATION WITH GESTATION AGE

is approved by the Research Committee.

Chair Person

Prof. & H.O.D.
Dept. of Bio-Chemistry
Sree Mookambika Institute of Medical Sciences
Kulasekharam 629 161

Convenor

Prof. & H.O.D.
Dept. of Physiology
Sree Mookambika Institute of Medical Sciences
Kulasekharam 629 161

Date :

APPENDIX - 2

INSTITUTIONAL HUMAN ETHICS COMMITTEE

SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES,
KULASEKHARAM, TAMILNADU

Communication of Decision of the Institutional Human Ethics Committee(IHEC)

SMIMS/IHEC No:1 /Protocol no: 32 / 2016

Protocol title: CAN SCORE IN NEW BORN BABIES AND ITS CORRELATION WITH GESTATIONAL AGE
Principal Investigator: Dr. M.Thirumalai Vasan
Name& Address of Institution: Department of Paediatrics Sree Mookambika Institute of Medical Sciences, Kulasekharam ☑ New review ☐ Revised review ☐ Expedited review
Date of review (D/M/Y): 15.12.2016 Date of previous review , if revised application:
Decision of the IHEC: ☑ Recommended ☐ Recommended with suggestions ☐ Revision ☐ Rejected
Suggestions/ Reasons/ Remarks:
Recommended for a period of : 18 months

Please note*

- Inform IHEC immediately in case of any Adverse events and Serious adverse events.
- Inform IHEC in case of any change of study procedure, site and investigator
- This permission is only for period mentioned above. Annual report to be submitted to IHEC.
- Members of IHEC have right to monitor the trial with prior intimation.

Reneegalyangadhar
Signature of Member Secretary IHEC

SREE MOOKAMBIKA INSTITUTE OF MEDICAL SCIENCES ★ KULASEKHARAM ★
IHEC
Date 21/12/16

APPENDIX - 3

CASE RECORD FORM

1) Serial no : ……..

2) Date of assessment : ……..

3) Name of the baby : .....

4) Age in days : ……..

5) Address & Phone no : .....

.....

BIRTH DETAILS

Date of birth ……. **Time of birth …….**

Birth weight ……. **Length …….**

Head circumference ……..... CAN SCORING …….

Gestation age …… LMP .....
(the new Ballard's scoring)

HISTORY

Consanguinity :

Obst scoring and Birth order :

LMP :

EDD :

Maternal medical conditions : Yes / No

If yes : ……..

……..

……..

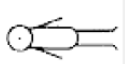
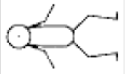
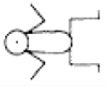
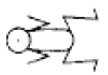
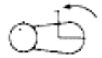
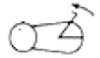
Maternal anthropometry

HEIGHT ..... WEIGHT..... BMI.....

APPENDIX – 4

BALLARDS SCORING

NEUROMUSCULAR MATURITY

SIGN	SCORE							SIGN SCORE
	-1	0	1	2	3	4	5	
Posture								
Square Window	 >90°	 90°	 60°	 45°	 30°	 0°		
Arm Recoil		 180°	 140°-180°	 110°-140°	 90°-110°	 <90°		
Popliteal Angle	 180°	 160°	 140°	 120°	 100°	 90°	 <90°	
Scarf Sign								
Heel To Ear								
TOTAL NEUROMUSCULAR SCORE								

MATURITY RATING

TOTAL SCORE	WEEKS
-10	20
-5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

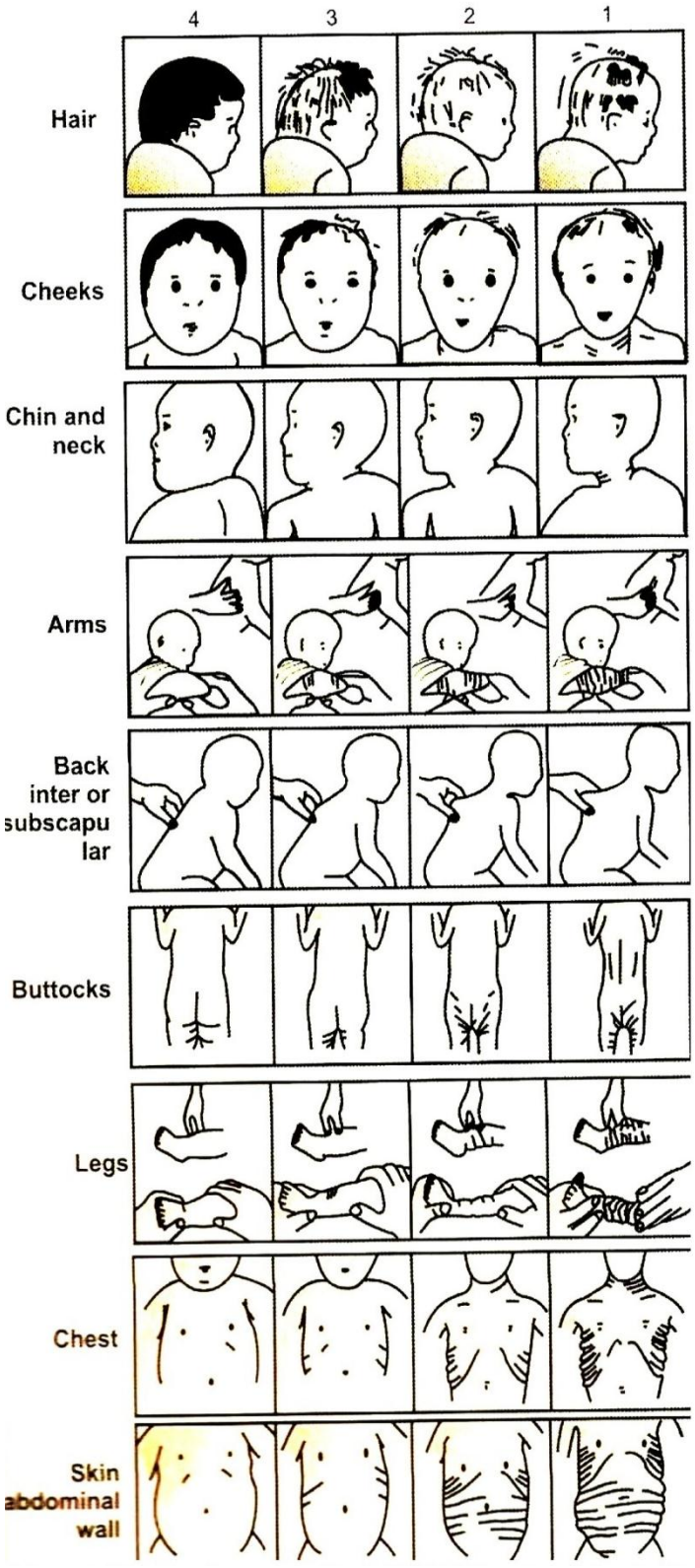
SIGN	SCORE							SIGN SCORE
	-1	0	1	2	3	4	5	
Skin	Sticky, friable, transparent	gelatinous, red, translucent	smooth pink, visible veins	superficial peeling &/or rash, few veins	cracking, pale areas, rare veins	parchment, deep cracking, no vessels	leathery, cracked, wrinkled	
Lanugo	none	sparse	abundant	thinning	bald areas	mostly bald		
Plantar Surface	heel-toe 40-50mm: -1 <40mm: -2	>50 mm no crease	faint red marks	anterior transverse crease only	creases ant. 2/3	creases over entire sole		
Breast	imperceptable	barely perceptable	flat areola no bud	stippled areola 1-2 mm bud	raised areola 3-4 mm bud	full areola 5-10 mm bud		
Eye / Ear	lids fused loosely: -1 tightly: -2	lids open pinna flat stays folded	sl. curved pinna; soft; slow recoil	well-curved pinna; soft but ready recoil	formed & firm instant recoil	thick cartilage ear stiff		
Genitals (Male)	scrotum flat, smooth	scrotum empty, faint rugae	testes in upper canal, rare rugae	testes descending, few rugae	testes down, good rugae	testes pendulous, deep rugae		
Genitals (Female)	clitoris prominent & labia flat	prominent clitoris & small labia minora	prominent clitoris & enlarging minora	majora & minora equally prominent	majora large, minora small	majora cover clitoris & minora		
							TOTAL PHYSICAL MATURITY SCORE	

Reference: Ballard JL, Khoury JC, Wedig K, *et al*: New Ballard Score, expanded to include extremely premature infants. *J Pediatrics* 1991; 119:417-423.

APPENDIX – 5

CAN SCORING

Project	Canscore			
	4	3	2	1 point
Hair	Thick, dense, smooth, satin-like, easy to comb	Thick, Scarce, there is little hair straight .	Hair thin, straight and put up with more hair	Sparse, straight and erect hair, the hair bundle associated with reduced pigmentation
Cheek	Plump, round face	Slightly reduced fat	Significantly reduced	Fat is almost gone, narrow face
Neck chin	Fat overlap into double or triple chin, neck cover	Slightly reduced fat chin, the neck can be seen	Fat pad thin chin, neck revealed	Chin fat disappears, the neck is clear, loose skin, wrinkle
Arm	Fullness, can not lift the skin	Arm a little thin, check on the pressure of hands, the accordion-like folds can be formed	Small arms, to form accordion-like folds	Very little fat, loose skin, accordion-like folds significantly
Back	Inter-scapular area of skin can not be picked	Little to lift the skin	Easy to lift and skin	Loose skin, easy to lift, wrinkles can form
Buttock	Fat pad thickness	Slightly reduced fat	Significantly reduced fat, hips tip, wrinkle	Fat disappears, fight wrinkles, loose skin and a very, kind of hip, such as pipe
Leg	Described with the same arm	Described with the same arm	Described with the same arm	Described with the same arm
Chest	Full, see the intercostal space	Intercostal space slightly visible	Intercostal space revealed	Intercostal space very clear, obvious loss of subcutaneous tissue
Abdomen	Fullness, thickness of subcutaneous fat	Slightly reduced fat	Abdominal wall thinning, can form the accordion-like folds	Abdominal bulging or boat-shaped abdomen, loose skin, can form the accordion-like folds


4
3
2
1
Hair
Cheeks
Chin and neck
Arms
Back inter or subscapu lar
Buttocks
Legs
Chest
Skin abdominal wall

APPENDIX – 6

MASTER CHART

Sl. No	IP No	AGE	Parity (Multi -M/ Primi -P)	ANEMIA	OTHER Maternal medical Conditions	Maternal BMI	Sex	Gestational age by The Ballard Score (weeks)	Preterm/Term/Postterm	Birth weight (kg)	length (cms)	Head circumference (cms)	Pondral Index	CAN Score	BABY BMI	Appropriate for gestational age/ Small for gestational age/ Large for gestational age
1	1603087	20	P	N		32.2	F	40	T	3.2	51	33	2.41	32	12.3	AGA
2	1608756	28	M	N		20.3	M	36	PT	2.5	48.5	33	2.1	23	10.6	AGA
3	1608844	18	P	Y	HT	19.4	M	38	T	2.6	48	31	2.3	28	11.3	AGA
4	1610980	23	M	Y		23.3	F	36	PT	2.5	47.5	30	2.3	22	11.1	AGA
5	1611092	18	P	Y		28.8	M	38	T	2.5	50	33	2	21	10.0	AGA
6	1612171	20	P	Y		20.9	F	38	T	1.6	42	29	2.15	16	9.1	SGA
7	1612779	23	P	Y	PIH	24.4	F	36	PT	1.8	47	30	1.7	19	8.1	SGA
8	1617996	21	P	N		20.2	F	38	T	2.6	47.5	31	2.4	26	11.5	AGA
9	1618577	27	M	Y		23.7	M	38	T	2.7	50	33	2.1	29	10.8	AGA
10	1618826	25	M	N		36.4	F	40	T	3	50	33	2.4	24	12.0	AGA
11	1618976	26	M	Y		20.8	M	38	T	2.8	50	33.5	2.2	30	11.2	AGA
12	1619308	20	P	Y		20.4	M	38	T	2.6	51	32.5	1.9	23	10.0	AGA
13	1619757	23	P	Y		18.4	F	38	T	1.75	44	32	2.1	23	9.0	SGA
14	1620079	24	P	Y		19.4	F	38	T	1.9	46	31.5	1.9	24	9.0	SGA
15	1620975	22	M	Y		17.9	F	38	T	1.75	48	31	1.5	21	7.6	SGA

16	1705197	20	P	Y		19.4	F	38	T	2.7	51	33	2	29	10.4	AGA
17	1705886	29	M	Y	GDM	27.6	F	38	T	3	49	35	2.5	32	12.5	AGA
18	1705934	23	M	Y	HT	22.4	F	38	T	2.7	49	31	2.2	28	11.2	AGA
19	1706258	20	P	Y		25.4	F	40	T	2.6	47	31	2.5	23	11.8	AGA
20	1710395	30	M	Y		22.2	F	38	T	2.5	52	33	1.77	22	9.2	AGA
21	1711803	20	P	Y		21.9	F	38	T	2	45	32	2.1	26	9.9	SGA
22	1712523	20	P	N		23.4	M	36	PT	2.6	47	33	2.5	28	11.8	AGA
23	1715415	20	P	Y		19.7	F	38	T	1.8	44	32	2.1	20	9.3	SGA
24	1716003	27	M	Y		21.6	F	38	T	2.6	48	30.5	2.3	25	11.3	AGA
25	1716035	20	P	N		24.7	M	38	T	2.5	48	31	2.26	26	10.9	AGA
26	1716057	24	M	Y		26.4	M	38	T	2.6	48	34	2.3	25	11.3	AGA
27	1716065	24	M	Y	BA	18.8	M	38	T	2.2	46	31	2.2	27	10.4	SGA
28	1716089	19	P	Y	BA	19.2	F	38	T	1.9	45	30	2	25	9.4	SGA
29	1716090	20	P	Y		18.2	M	38	T	1.6	45.5	30.5	1.7	18	7.7	SGA
30	1716096	20	P	Y		23.9	M	40	T	2.6	48	31	2.35	25	11.3	AGA
31	1716106	20	P	Y		29.9	M	38	T	2	47	30	1.92	24	9.1	SGA
32	1716168	20	P	Y		24.7	F	40	T	2.6	48.5	34	2.2	24	11.1	AGA
33	1716188	31	M	Y		21.7	M	38	T	2	44	30	2.34	20	10.3	SGA
34	1716226	24	P	Y		24.8	M	40	T	3	51	31	2.2	23	11.5	AGA
35	1716286	19	P	Y		21.1	F	40	T	2.6	47	32	2.5	22	11.8	AGA
36	1716296	20	P	Y		23.8	F	38	T	1.6	46	30	1.6	18	7.6	SGA
37	1716341	19	P	Y		27.4	M	40	T	3.2	52	34	2.27	24	11.8	AGA
38	1716349	24	P	Y		19.6	F	36	PT	1.6	45	31	1.75	17	7.9	SGA
39	1716490	19	P	Y		21.4	M	38	T	2.6	48	33	2.3	22	11.3	AGA
40	1716513	20	P	Y		20.9	M	36	PT	1.5	43	29	1.8	19	8.1	SGA
41	1716526	19	P	Y		24.6	M	38	T	2.25	49	31	1.9	25	9.4	SGA

42	1716528	22	P	Y		22.3	F	40	T	2.4	46	31	2.4	27	11.3	SGA
43	1716587	19	P	Y		19.8	F	40	T	2.75	48	31	2.4	24	11.9	AGA
44	1716640	27	M	Y		17.7	M	38	T	1.8	43	31	2.2	22	9.7	SGA
45	1716684	29	M	N		22.5	M	38	T	2.2	48	30.5	1.9	24	9.5	SGA
46	1716727	23	M	N	HT	25.1	F	40	T	2.7	48.5	31	2.3	21	11.5	AGA
47	1716758	18	P	Y		26.4	M	38	T	2.7	48	31	2.44	23	11.7	AGA
48	1716796	24	P	Y	HD	29.2	M	38	T	1.7	44	30	1.9	17	8.8	SGA
49	1716819	25	P	Y	HT	27.8	M	40	T	2.8	51	32	2.1	24	10.8	AGA
50	1716834	25	P	Y		24.6	F	36	PT	2.6	41.5	30	2.32	22	15.1	AGA
51	1716868	19	P	Y		22.9	M	38	T	2.7	49.5	31	2.2	23	11.0	AGA
52	1716873	19	P	Y		23.2	F	38	T	2.75	52	34	1.9	21	10.2	AGA
53	1716897	26	M	Y	BA	24.4	M	40	T	2.9	51	31	2.1	32	11.1	AGA
54	1717219	18	P	Y		22.3	M	38	T	1.7	42	30	2.2	23	9.6	SGA
55	1717378	23	M	Y	PIH	28.2	F	38	T	1.75	47	31	1.68	18	7.9	SGA
56	1717420	23	P	Y		26.8	M	38	T	1.9	47	31	1.83	18	8.6	SGA
57	1717431	24	M	Y		22.6	F	40	T	2.7	48	31	2.4	30	11.7	AGA
58	1717435	24	M	Y		24.2	F	40	T	2.7	50	32	2.1	24	10.8	AGA
59	1717490	19	P	N		20.8	M	40	T	2.8	49	32	2.3	31	11.7	AGA
60	1717503	23	P	Y		18.9	M	40	T	2.2	47	31	2.11	22	10.0	SGA
61	1717509	22	P	Y		20.4	F	38	T	2.7	52	33	1.9	23	10.0	AGA
62	1717532	25	M	Y		28.3	M	40	T	2.5	50	31	2	22	10.0	AGA
63	1717540	25	P	Y	BA	21.6	M	38	T	1.9	45	32	2	19	9.4	SGA
64	1717549	19	P	Y	GDM	32.6	M	36	PT	2.6	50	32	2	21	10.4	AGA
65	1717596	20	P	Y		25.3	F	38	T	2.6	49	31	2.2	21	10.8	AGA
66	1717600	24	P	Y		19.5	M	38	T	1.8	46	31	1.8	20	8.5	SGA
67	1717637	28	M	Y		22.4	M	38	T	2	47	31.5	1.92	26	9.1	SGA

68	1717659	22	M	Y		23.5	F	38	T	2.6	48	33	2.3	23	11.3	AGA
69	1717725	19	P	Y	BA	20.8	F	38	T	1.86	43	32	2.33	19	10.1	SGA
70	1717747	20	P	Y	BA	22.4	M	38	T	2.5	46.5	32.5	2.4	21	11.6	AGA
71	1717833	24	M	N		21.8	M	40	T	2.1	48	30	1.8	24	9.1	SGA
72	1717852	20	P	Y		27.9	F	38	T	1.8	46	30	1.52	23	8.5	SGA
73	1718440	23	M	Y	HT	20.7	F	36	PT	2.5	46.5	32	2.4	26	11.6	AGA
74	1724792	22	P	N		21.3	F	38	T	2.7	48.5	31.5	2.3	30	11.5	AGA
75	1724796	30	M	N		29.2	F	38	T	2.7	49	33	2.29	29	11.2	AGA
76	1728841	19	P	Y	HT	26.6	M	38	T	2.8	49	31	2.3	23	11.7	AGA
77	1730065	21	P	Y		20.6	F	36	PT	2.75	51.5	33	2	32	10.4	AGA
78	1802295	25	M	Y		21.7	M	40	T	3	52	34	2.1	33	11.1	AGA
79	1802487	24	P	Y		22.2	M	38	T	2.8	48	30.5	2.5	30	12.2	AGA
80	1804926	26	P	Y		23.6	M	38	T	1.7	46	30	1.74	22	8.0	SGA
81	1808045	26	M	Y		35.3	M	40	T	2.8	48.5	30	2.4	24	11.9	AGA
82	1809339	19	P	Y	SLE	21.5	M	40	T	2.75	48	31	2.48	30	11.9	AGA
83	1809485	26	M	N		24.4	M	38	T	2.8	50	33	2.2	22	11.2	AGA
84	1898442	23	P	Y		18.5	M	38	T	1.54	43	29	1.93	16	8.3	SGA